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Impact on Transportation During Covid-19 Crisis and Road Safety Measures in Pandemic

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❖ Abstract :-

The briefing to know how countries are facing problems during pandemic an overview on the state of play trends of urban transport since the outbreak of the COVID-19 pandemic. It results four scenarios, the prevalence of one or the other depending on the priorities Settled by policy makers and assistance advisers. The guidelines deliver general suggestions for a post-COVID-19 smart and sustainable urban transport mobility and a set of desirable actions on how to integrate EU response into existing strategy priorities.

Against the crisis of a continuously changing environment, the aim of this paper is to discuss the impact of COVID-19 crisis in Italy, the government response to cope with the crisis and the major lessons learned during its managing in pandemic. The analysis data to observe how Italy's faced response has been characterized by some rapid measures to implement the health crisis, but few plans in the mitigation stage and a push back of community involvement. This contribution pressure and its importance of a cultural shift, through the effort to apply in practice the principles already indicated in the main global policy frameworks to guide disaster throughout the country. A community social development approach can help to build new formation of healthy country.

The Italian Authority has decreed a series of continuous limitations to delay the COVID-19 pandemic spreading in Italy since March 10, 2020, including limitation in person-to-person mobility and the closure of social, cultural, economic, and industrial activities. Here we show the lockdown consequence in Northern Italy, the COVID-19 most affected area, as revealed by noise variation at seismic stations. The reaction to lockdown was slow and not homogeneous with spots of minor noise reduction, especially in the first week. A fresh interpretation of seismic noise variations in terms of socioeconomic indicators sheds new light on the lockdown efficacy pointing to the causes of such delay: the noise reduction is significant where non planning activities prevails, while it is small or negligible where dense population and strategic activities are present. These results are key for analytic interpretation of the pandemic transmission and the effectiveness of differently targeted political actions.

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Chapter-1

1) Introduction

The effect of Coronavirus on urban mobility has long enduring consequences. In more detail, the focus of this section is to examine how Covid-19 discipline measures changed people's habits in reaching urban places and services, thus control the mobility subsystem. Urban system mobility is very composite and depends on several factors, primarily on it's ways users move around the cities (walking, cycling, by buses or underground), on the level of easy reach to a place and the organization and structure of the public transport supply. The spread of the virus varied across areas, with the most majority of cases concentrated in some of the richest and most industrialized regions of the North, those with the most advanced health systems. As per 1 April 2020, Lombardy experienced **44,733** cases and **7,539** deaths. In Veneto, the corresponding values were **9,625** and **499**. A community-based approach in Veneto, with extensive contact tracing and more rapid testing appears to be associated with substantially reduced rates of cases, hospitalizations, deaths, and infection compared with the hospital-centered approach in Lombardy. The regional government took action to strengthen its ability to trace the contagion, by starting to independently produce the chemical reagents needed to process thousands of swabs. There are 8 public health prevention departments in Lombardy (1 per 1.2 million), compared with 9 in Veneto (1 per 0.5 million). In Lombardy, 51.5 per cent of the patients were admitted, including 5.2 per cent to intensive care units. In Veneto, the corresponding figures were 25.1 per cent and 4.3 per cent, respectively.

While urban areas can enable access to important social and economic opportunities, they have also brought about new challenges related to traffic overcrowding, air- and noise pollution, and ineffective transport systems. The shift towards smart and more livable cities therefore places a particular responsibility on the transport sector, which accounts for a quarter of the Union's total greenhouse gas discharge and which is a significant supporter to health-damaging pollution in cities.

In the hard-hit Italy, public transport ridership has seen decreases in the range between 80% and 90% in every major cities. In the short-to medium-term the most urgent priorities will therefore be to address the economic viability of the affected businesses across the industry as well as to make certain the safety of the travelling public once lockdown measures have been phased out.

1.1) Worldwide covid-19 pandemic impacted to cause travel issues.

1.1.1) Importance of Transportation.

Transportation is divided into private and public transport. An important distinction to reach in time must have to choose type of transport is mode of transport. In an urban context, the most relevant modes of transport will typically operate under transportation objects like Road network, Air ways, Rial ways etc.

Transport is important because it enables communication, trade and other forms of exchange between people, that in turn establishes civilizations. Transport plays an important part in economic growth and globalization, but most types cause air pollution and use large amounts of land. Good planning of transport is essential to manage traffic flows and restrain urban sprawl. Yet, transportation is generally very vulnerable for security threats. It is an attractive target because of its importance in society and the presence of large amounts of people or crowds. High quality transport links ensure that communities can access basic services, facilities, and employment opportunities. The connectivity provided by such links promotes social inclusion, can reduce social isolation, and enhances quality of life.

Fig -1 In May 25 aerobatic team Frecce Tricolori (Tricolour arrows) fly over Milan Italy.

The COVID-19 crisis in Italy has uprooted life in the country and prompted emergency measures at a level not seen since the war. Some images from Italy under lockdown will be difficult to forget.

Italy was the first European country to be hit by the coronavirus back in February, and the first disruptions to normal life seemed monumental. A polemic arose between those determined for life to continue as normal, and those more cautious about the potential effects of the virus. Images from the final days of Venice Carnival before it was canceled, express the opposing mindsets as carnival-goers in elaborate masks juxtaposed tourists already donning protective face masks.

1.1.2 Worldwide Safety for Travelers.

Fig-2 During Lockdown safety travel throughout the world.

- While COVID-19 cases continue to rise and fall around the world, some countries have opened their borders to travelers. The European Union Council has released a series of recommendations on travel restrictions within the EU, as well as from a select number of countries outside the EU. This map offers the latest EU COVID-19 travel data and guidelines. In recent months, new surges in cases, new variants of the virus have caused some nations (in Europe and elsewhere) to tighten their entry requirements again.
- The United States is not currently on the list of nationalities the EU has recommended allowing in (as of October 22). However, a few European countries and several countries outside Europe are welcoming US visitors, including the Maldives, Tanzania, Ecuador, Costa Rica, French Polynesia, Egypt, Turkey, Thailand, a number of Caribbean nations, and Mexico. New Zealand has also considered creating a "travel bubble" where it would open its border to travelers from Australia and vice versa.

An increasing number of countries are now requiring proof of a negative COVID-19 test before travelers depart their own country or upon arrival. Those who test positive on arrival may be required to quarantine (and some countries require all travelers to undergo a period of quarantine, whether it is not they provide a negative test result).

Despite these precautions, COVID-19 has not gone away – it remains a serious risk throughout the world. But the desire to travel has not gone away, either. Recent news of COVID-19 vaccines being rolled out has caused a surge in travel bookings. Yet it will be several months before those vaccines are widely available, and even longer before large proportions of the population can be considered immune.

1.1.3) Safe travel tips during COVID-19.

Preventing the spread of COVID-19 is a shared responsibility. Millions of people are dependent on tourism for their livelihoods – but opening their doors puts them and their fellow citizens at risk. So, if a country welcomes you, the decent thing to do is to comply with its requirements, not present it with a new outbreak.

- Wear a mask on your flight and wherever requested at your destination. If there are few restrictions at your destination, you should strongly consider wearing a mask in public anyway. Studies have shown that masks help prevent the spread of COVID-19, and the more of us who wear them, the better. According to WebMD, "N95 masks are the most protective masks, followed by a three-ply surgical mask, then a fabric mask."
- Wash your hands thoroughly and regularly, avoid touching your face. While washing with soap and water is the most effective way to avoid getting sick, it's also wise to carry hand sanitizer for situations where washing hands may not be possible.
- Practice social distancing – maintain distance of 1m or more from people outside your own household/other than your immediate travel companions.

If you've received two doses of the COVID-19 vaccine, great! However, you still need to wear a mask and social distance. It's not yet known whether getting the vaccine prevents those who've been vaccinated from spreading the virus to others, even if they don't get sick themselves.

1.2) Risk-based stages for mitigation measures

1.2.1) Useful steps to be advised while travelling in air.

Resumption of higher volumes of passenger air travel will be dependent on number of factors, including foremost public health agency guidelines (driven by travel risk levels), governmental travel restrictions and requirements, passenger confidence, and air carrier and airport operational capacity.

A risk-based approach will enable the transition between stages of restarting operations and the adjustment of mitigation measures based on risk, while recognizing that reverting to previous stages may be necessary. The goal is to maximize consistency and develop criteria for data reporting and the monitoring processes in support of evaluation and progression to the next stage(s). It is currently not feasible to provide any specificity of timing between these stages. At the time this document was published, most of commercial passenger aviation was in Stage 0 or 1.

Stage 0:

A situation with travel restrictions and only minimal movement of passengers between major domestic and international airports.

Stage 1:

Initial increase of passenger travel. This initial stage will coincide with relatively low passenger volumes, allowing airlines and airports to introduce aviation public health practices appropriate to the volume. There will be significant challenges as each stakeholder community adapts to both increased demand and the new operational challenges associated with risk mitigation. Health measures for travel required at airports will need to, at a minimum match those from other local modes of transport and infrastructure.

Stage 2:

As health authorities review the applicability of measures based on recognized medical criteria, passenger volumes will continue to increase. Several measures that were required in Stages 0 and 1 may be lifted. Health measures for travel required at airports will need to match those from other local modes of transport and infrastructure.

Stage 3:

This stage may occur when the virus outbreak has been sufficiently contained in a critical mass of major destinations worldwide as determined by health authorities. The reduction of national health alert levels and associated loosening of travel restrictions will be key triggers. Risk mitigation measures will continue to be reduced, modified, or will be stopped in this stage. There may not be effective pharmaceutical interventions (e.g. therapies or vaccines) commonly available during Stage 3, but contact tracing and testing should be readily available. Until specific and effective pharmaceutical interventions are available, States may need to continue to loosen or reinstate public health and social measures throughout the pandemic.

Stage 4:

This stage begins when specific and effective pharmaceutical interventions are readily available in most countries. There may be a set of residual measures/mitigations that could be retained, although these should also undergo a periodic review process.

1.2.2) Coronavirus Impacted on Transportation of EU in pandemic

1.2.3) A coordinated approach to measures restricting free movement in the EU

EU citizens have the right to free movement within the EU. At the same time, the current pandemic has led to various restrictions across the EU. To provide clarity to citizens and make their lives easier Member States have agreed to improve their coordination. They will share the latest epidemiological data with the European Centre for Disease Control which will publish a map of Europe (also including data from the Schengen Associated States), updated weekly, in a variety of colors depending on the risk in a given region.

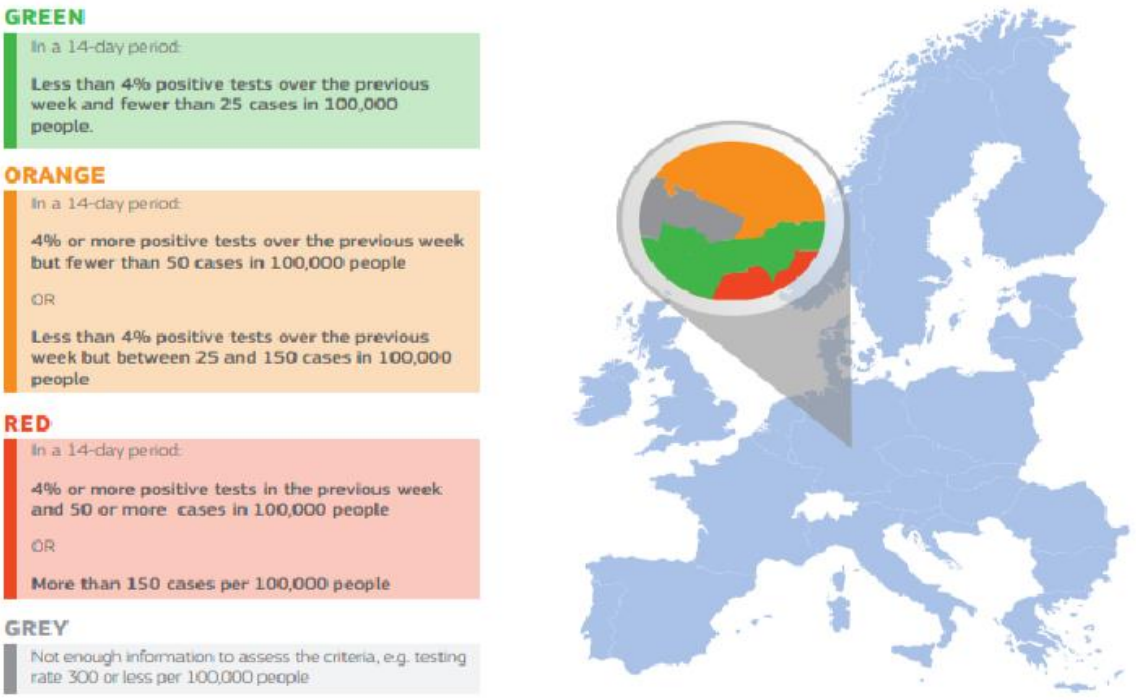


Fig-3 Restriction zones called by EU with different colors.

There will be no restrictions if you are travelling from a "green" region. When travelling from an "orange" or a "red" region, national governments may ask you to get tested or undergo quarantine. Governments will give clear and timely information before they introduce such measures.

1.2.4) How are my free movements rights protected when travelling in the EU during pandemic.

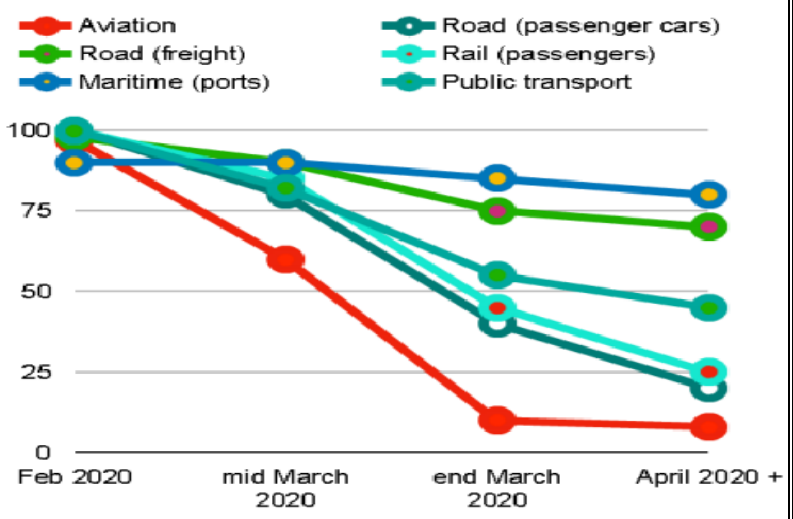
1) you can travel from green region without any restrictions.

2) you are always allowed to go back to your member state of nationality or residence.
3) you should not be discriminated against.
4) any measures restricting your free movement must be proportionate,
but you should not -in principle – be refused entry.
5) if you travel of an essential function or need, you will not be required to quarantine.

1.3) Future of Transport: Update on the economic impacts of COVID-19.

1.3.1) Direct impacts on transport and. Mobility.

Traffic and transport operations are the reflection of the social and economic activity. During the pandemic, the measures applied in order to limit the propagation of the disease resulted in extensive mobility restrictions with a pronounced impact on most transport modes.



Graph-1 Change in Transportation Activity EU27.

Air transport is the most affected sector, with more than 90% of programmed flights in EU27 cancelled. Passenger car traffic decrease by 60% to 90%, while public transport and passenger rail decreased by more than 50% in most Member States. The freight sector was more resilient, since supply chains were mostly kept open to support the continuing productive operations. Nevertheless, the pause in non-essential activities in some Member States and the decrease in retailing had a visible impact in certain segments of transport, Traffic and transport operations are the reflection of the social and economic activity.

During the pandemic, the measures applied in order to limit the propagation of the disease resulted in extensive mobility restrictions with a pronounced impact on most transport modes. Air transport is the most affected sector, with more than 90% of programmed flights in EU27 cancelled. Passenger car traffic decrease by 60% to 90%, while public transport and passenger rail decreased by more than 50% in most Member States. The freight sector was more resilient, since supply chains were mostly kept open to support the continuing

productive operations. Nevertheless, the pause in non-essential activities in some Member States and the decrease in retailing had a visible impact in certain segments of transport, distribution and logistics. Maritime transport and port traffic were affected by the reduction in the trade with China during the early phases of the pandemic but is showing signs of recovery. Demand for transport and mobility services will probably rebound once restriction measures are removed and activity gradually recovers. Nevertheless, the rate of recovery will vary across transport modes and Member States and will depend to a large extent on the speed of economic recovery, the cost of the measures to support it and the changes in the supply and demand of transport services as a result of the direct and indirect impacts of the pandemic. A clear picture of the full impacts will, most likely, not be possible before the end of 2021 and the repercussions will be probably still visible at least 3 years after the crisis. The main conclusion of the analysis was that the improvement of transport governance and the development of innovative mobility solutions with the engagement of citizens will be crucial to ensure that the future of transport is cleaner and more equitable than its car-centered present. The response to the COVID-19 pandemic and the recovery path in its aftermath can influence the evolution of the various factors and make the need for improved governance and innovativeness even more urgent.

1.3.2) Change in mobility demand patterns.

The pandemic crisis is already considered as one of the greatest shocks in the last 60 years, strong enough to modify future needs and social values. Several of the changes in personal priorities may persist in time, even after the eventual recovery. On one hand, social distancing has accelerated the adoption of technological solutions that help avoid transport. Teleworking, video-conferencing and other remote collaboration methods have long been seen as potential solutions for reducing transport demand.

The extensive adoption of such solutions by a large share of enterprises during the crisis will probably result in an increased share of employers and employees continuing to use them once the confinement measures are over. On the other hand, the increase in e-shopping during the crisis -as a response to limitations in retailing, risk aversion and social distancing- is also expected to be sustained in the future. Either as employees or as consumers, many individuals will limit trips that can be avoided through technology, or simply because they would consider them unnecessary.

Regardless of how soon the COVID-19 threat is over, the uncertainty concerning the possibility of new waves of the virus or other pandemics will remain in the near future and will probably lead to a higher risk aversion towards transport and travel. Apart from decreasing the trip frequency at individual level, the user preferences concerning transport modes and trip distances will also possibly change. As discussed in the JRC Future of Transport report, public transport is especially vulnerable to the changing trends in society and technology.

Emerging mobility technology and business models already threatened the role of public transport demand by shifting users to ride hailing services, shared mobility applications and micro mobility solutions (electric bicycles, e-scooters, etc.). In a post-pandemic situation, it is possible that a part of the population will avoid public transport due to disease transmission concerns and opt for more individualistic forms of mobility. Such behavior can shift demand back to private cars, biking (conventional or electric), micro-mobility and even walking. But probably favoring own vehicles as opposed to shared mobility options. “Sharing economy” services such as ride hailing, ride sharing, and other emerging Mass (Mobility as a Service) applications are therefore expected to face important viability problems as a result of the loss of income during the confinement period and the decreased demand afterwards. Air travel is the hardest hit transport mode. Its activity in the EU decreased by 90% during the pandemic and the high capital costs of airlines and airports make the survival of several actors questionable in the short term.

Trips in the 400 km to 1000 km distance band though will probably not be affected as much as the longer distance trips by air, and rail may benefit from the substitution effect of trips not released by air. However, trips that require indirect connections through intermediate stations or combinations of more than one transport modes are likely to be less attractive to travelers.

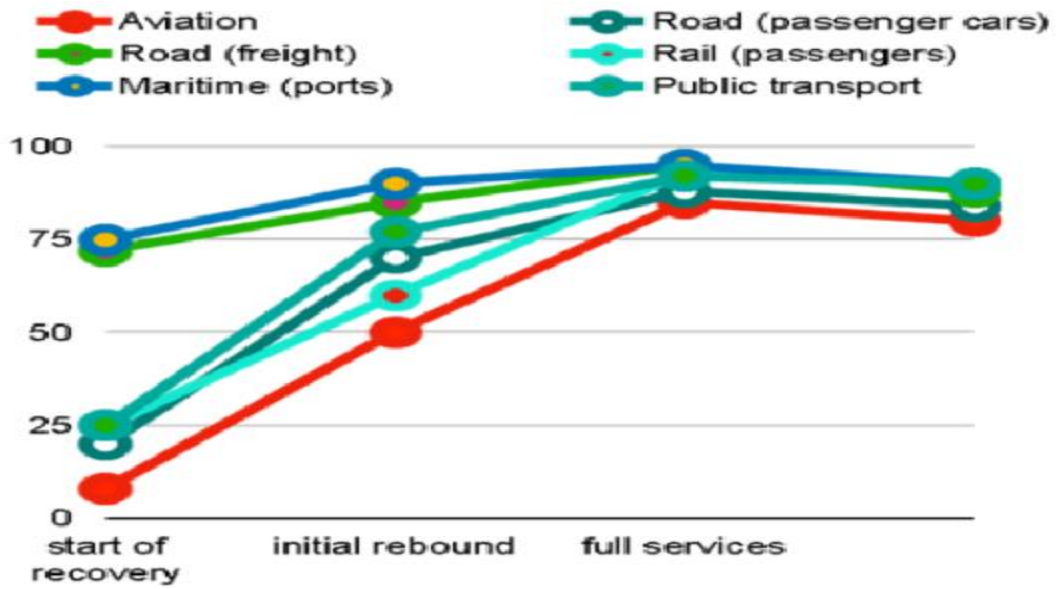
A potential economic slowdown would also affect overall demand and limit the development of the sector in terms of new investment and market opening. On the other hand, freight transport is more resilient to the direct impacts during the confinement period but very sensitive to the speed of the economic recovery. Production and supply chains maintained their operational capacity but can eventually be negatively affected by a drop in final and intermediate demand. However, the concerns raised during the pandemic may cause a deceleration of the globalization in supply chains to avoid future risks. Several countries and businesses will probably attempt to source their inputs from producers which are closer to them and cause at least a marginal decrease in the transport

intensity of their operations. E-commerce witnessed an increase in demand during the confinement period and will probably have a more important role in future consumption patterns.

The trends of digitization in logistics and distribution systems are therefore expected to continue reshaping urban and distance freight transport. The path to recovery for the transport sector depends on the strategy that will be followed in terms of the gradual relaxation of restrictions, the future operational rules that will affect the supply side and the rate of improvement of the general economic conditions. Figure 2 presents an initial estimate of the differential reaction of each transport mode, assuming that each mode reached minimum activity during the crisis and will gradually converge towards its baseline level. Changing mobility patterns and economic uncertainty would be, however, limiting factors in the medium term.

1.3.3) Health and safety measure

Most operators in both passenger and freight transport will be probably required to improve their health & safety standards through the introduction of additional controls, disinfection procedures and additional protection equipment, e.g. improved High Efficiency Particulate Air (HEPA) filters. At least for the first months of the gradual return to normality, limits to the number and density of passengers and personnel in vehicles, vessels and aircraft (and stations, ports and airports) should be expected. Such measures will be necessary in order to minimize the potential spread of future waves of infectious diseases and -at least as important- to provide a sense of security to users. The drawbacks, however, would be the cost increase and service limitations for transport operators, and the added inconvenience for transport users.



Graph-2 Indicative scenario of transport activity recovery, JRC estimates (baseline=100)

1.3.4) Impact on Innovation.

Being the direct outcome of economic and social activity, transport and mobility should normally rebound in line with the speed of recovery back to normality. Apart from the direct impacts to transport demand from an economic slowdown, a lower investment in transport infrastructure, equipment and services may also affect the supply side. Public budgets will be channeled towards the post-pandemic crisis mitigation and the private sector may be facing liquidity problems, in both cases limiting the amounts available for transport related investments.

The construction of transport infrastructure and the technology-led innovation in vehicle manufacturing are two sectors with a large economic impact in the EU that may strongly be affected by a financial crisis. In addition, lack of funding or risk aversion may limit the prospects of innovation in number of emerging technologies and applications in transport. These include the start-up ecosystem of new mobility options and business models or high uncertainty concepts such as the hyper-loop.

1.3.5) Public policy priorities.

How EU policy priorities will be re-orientated as a response to the post-pandemic challenges will to a large extent shape how the transport sector will evolve. For example, maintaining the ambitions of the European Green Deal3 as part of the recovery measures can be a form of stimulating the EU vehicle manufacturing sector. At local policy level, it can be an opportunity to promote micro-mobility and clean transport modes to improve the environmental quality but also support innovation.

1.3.6) Policy Options.

Several operators, especially in air transport, will potentially require direct or indirect state support in order to maintain a level playing field while also ensuring the competitive position of EU operators at international level. Public transport and aviation are particularly vulnerable to the impacts of changing in user choices, worsening economic conditions and, tightening public budgets. State Aid rules will probably need to be updated and potentially take criteria such as preserving connectivity or minimum service into account. Health and Safety guidelines for all transport modes across the EU, including a time line for their application, are needed in order to ensure public trust and a uniform adoption by all operators.

They should address issues ranging from cleaning and disinfection standards to limitations to the allowed density of passengers across all types of publicly used transport mode. The European Green Deal priorities for mobility are compatible with a post-pandemic strategy for the transport manufacturing and service sectors.

1.4) Milan announces ambitious scheme to reduce car use after lockdown.

1.4.1) Coronavirus-hit Lombardy city will turn 35km of streets over to cyclists and pedestrians.

Milan is to introduce one of Europe's most ambitious schemes reallocating street space from cars to cycling and walking, in response to the coronavirus crisis. The northern Italian city and surrounding Lombardy region are among Europe's most polluted, to have also been especially hard hit by the Covid-19 outbreak. Under the nationwide lockdown, motor traffic congestion has dropped by 30-75%, and air pollution with it. City officials hope to fend off a resurgence in car

use as residents return to work looking to avoid busy public transport. The city has an announced the at 35km (22 miles) of streets will be transformed over the summer, with a rapid, experimental citywide expansion of cycling and walking space to protect residents as Covid-19 restrict ions are lifted. The road plan, announced on Tuesday, includes low-cost temporary cycle lanes, new and widened pavements, 30kph (20mph) speed limits, and pedestrian and cyclist priority streets. The locations include a low traffic neighborhood on the site of the former Lazzaretto, a refuge for victims of plague epidemics in the 15th and 16th centuries. Marco Granelli, a deputy mayor of Milan, said: "We worked for years to reduce car use. If everybody drives a car, there is no space for people, there is no space to move, there is no space for commercial activities outside the shops.

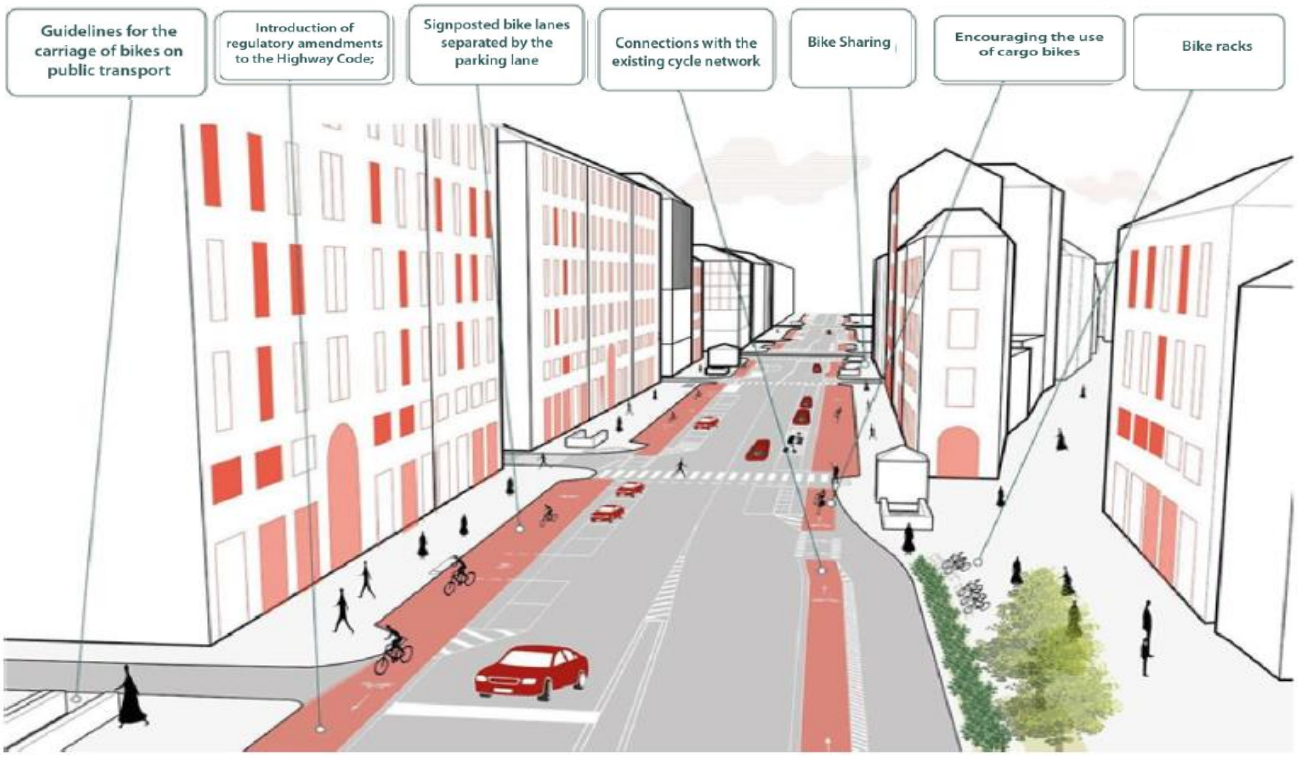


Fig-4 In Milan roads the new track for cycle path along with pedestrians.

To limit the use of cars in view of the post Covid-19 reopening, Milan has a cutting-edge plan. It calls for wider pavements and an extensive network of new cycle paths, ensuring low-impact mobility and social distancing. The urban transformation works begin in the month of May.

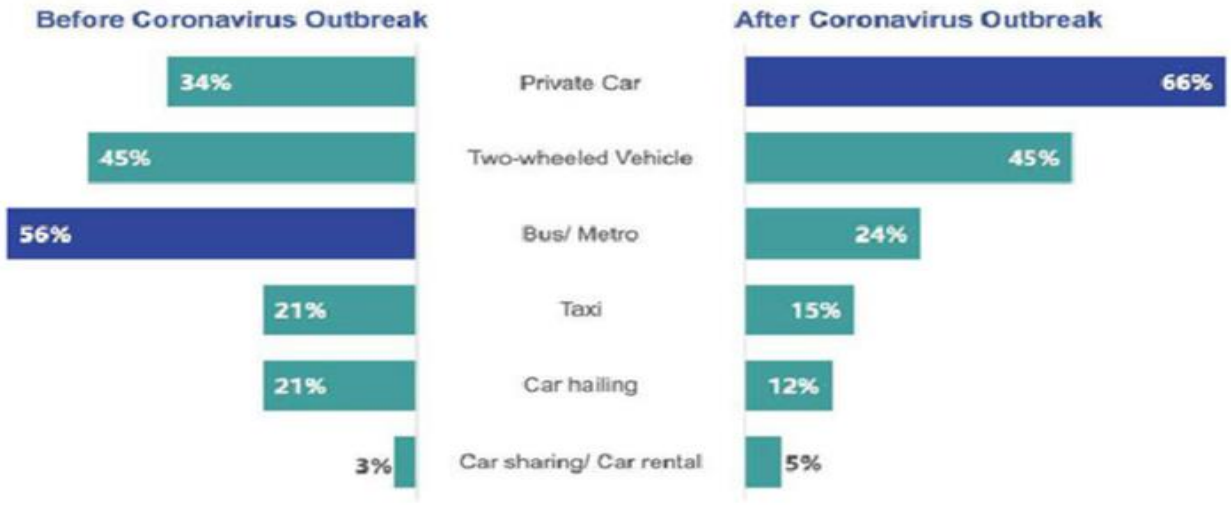


Fig-5 Modal share in the Wuhan region, before and after the Coronavirus emergency. Source: from Fabio Pasquali (Italy).

To forestall this danger, the Municipality has just launched the (Open Streets) plan, praised on Twitter by Greta Thunberg and highlighted by the British newspaper *The Guardian* as **one of the most ambitious urban projects in Europe in response to Covid-19**. Starting in May and scheduled for completion by the end of the summer, the plan calls for a whopping 35 kilometers of city streets to be modified to extend the network of cycle paths and pedestrian paths, all through low-cost interventions.

Fig-6 Bicycle ways of Milan in distance Kilometers.

"In Milan, public transport passengers will decrease from 1.4 million passengers per day to 400,000. We cannot accept them turning into a million cars", explained the deputy mayor for mobility Marco Granelli. **Open street eco-sustainable forms of transport that are alternatives**

to cars (bicycles as well as e-bikes and electric scooters), includes reducing speed limits to 30 km/h and designating streets where pedestrians and cyclists have priority.

Paris, Vienna, Barcelona, London, Brussels, Milan. There is a common thread that, in this moment of global pandemic crisis, unites the policies of European administrations in terms of social distancing and safety. Cities must gradually return to normal, but with the use of public transport needing to be reduced by 75% due to the virus, they have avoid giving the "green light" to cars, which would bring traffic and pollution back to the level of ten years ago.

Fig-7 Pedestrian walk and bicyclic tracks.

1.4.2) Generating new road plans for use daily users.

Fig-8 Design of road after pandemic hit to the country

In order to be able to implement the plan quickly the paths being created will be "signage-only", defined not by curbs but by simple coloured lines on the asphalt, carved out next to the pavement by moving parked cars about a metre towards the centre of the roadway. Then they hope a growing number of citizens will convert to the use of bicycles and scooters, modes of transport that moreover are ideal in a flat city like Milan. Tax incentives like those successfully implemented for example, could be useful.

Conclusion

Many countries are effected by the covid-19 crisis that cause lot of loss to whole world as a result the EU (European Union) region also has the problems in decrease the population due to pandemic a large number of deaths are taken places, every day rapid increase in new cases of covid-19 patients the virus was very new in the month of March so doctors work load is heavy to treat the patients to cure situation is in control by this condition after having positive symptoms the patients can't breathe properly positive covid-19 should not travel or move out from they can for medical help.

Coming to the mobility and transportation reduction of vehicle on the road's government implemented lockdown seriously everyone must follow the guide line given by the government or by the world health organization (W-H-O) precautions and everyone must consider their own safety measures person to person. By this reason, the people likely to travel by their private vehicle, there was fear in the people if travel through public transport there are many issues to keep and maintain the safety distance near around (1m) or in six feet distance must have to follow. Gradually the EU countries economy is reduced loss to transport industries and government logistic transport hits major loss in their business.

The above lesson we saw the example of the Milan (Italy) new lines are made on the pavement side by side to the road, the lines for bicycle way, pedestrian walk during lockdown it was easy process to create new construction work due to less very less traffic on the roads as the above pictures shows the bicycle liens and pedestrian walk. This work is done in many cities of Italy and throughout the EU countries. Now in this period in 2021 year the countries gradually reduction of the cases of covid-19 world is coming to stage of recovery period.

Capter-2

2.1) In COVID-19 crisis reduction of Transportation in Asia.

Transport has played a central role in the spread of the virus. It has also played a critical part in enabling frontline and essential workers to get to work during the pandemic. Will continue to represent an enabler in terms of supporting the different needs of the population throughout the different stages of recovery. The pandemic's impact on passenger and freight transport has been profound. Mobility restrictions in response to COVID-19 have resulted in drastic changes in travel behavior.

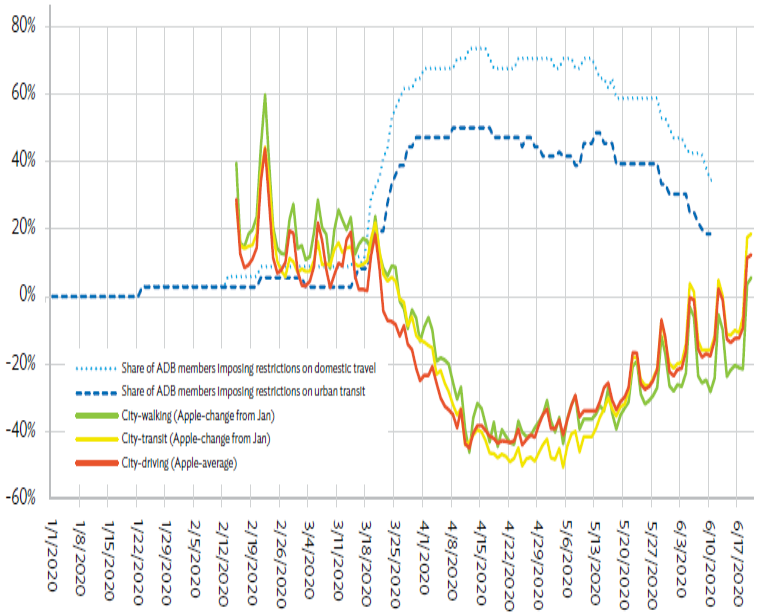


Fig-9 Impact of COVID-19 on Transport in Asia and the Pacific

ADB = Asian Development Bank, COVID-19 = coronavirus disease.

Swift lockdowns across the globe forced all nonessential workers to work from home almost overnight, and schools to shift to e-learning. With the closure of brick-and-mortar shops and restaurants during the containment period, consumers flocked to online shopping and food delivery. The sharp reductions in economic activity have also curbed regional and national freight, transport activity. On the other hand, in many places, urban freight and logistics have prospered because of increased online shopping and food deliveries.

Some governments have launched financial stimulus measures in response to the COVID-19 pandemic. The transport sector is benefiting from these through financial support to the airline industry, the automotive sector, and public transit companies. In the case of repeated waves of transmissions, countries may fall back to earlier phases midway through the recovery and repeat the successive phases in the three-stage process. This is a stylized strategy; it is important to be aware that the actual response will vary between countries and cities, and between different transport subsectors within countries and cities.

In the response phase, travel is still expected to be limited, with the focus mainly on allowing essential workers to travel and enabling the shipment of goods. Measures include protecting transport staff and passengers, as well as frequent cleaning and sanitization. Complementing these, a robust system of contact tracing and health monitoring needs to be put in place.

2.2) How COVID-19 is Changing Travel Demand and Mobility Patterns in Asia

The pandemic has forced all transport users to reassess the necessity of their trips and resulted in temporary new travel patterns. At this point, it is hard to predict the extent to which these new behaviors will be sustained. It is probable that, even after lockdowns are lifted, work-from-home and e-learning arrangements will still be used more frequently compared with pre-COVID-19. This could change travel behavior and patterns, including the frequency and distance of trips.

COVID-19-related road safety measure. Volunteers spray disinfectants on vehicles in the streets in Dhaka, Bangladesh (photo by Abir Abdullah/Asian Development Bank)

including in Asia, imposed large-scale stay-at-home and quarantine notices, and implemented swift measures to move work and schools online, close recreational venues and public places, and ban large-scale events and gatherings. An overwhelming majority of economies have been affected, regardless of the extent to which restrictive measures were implemented—reflecting the high degree of interdependence among countries. Travel demand across all transport subsectors has fallen dramatically, with aviation the most severely affected.

2.3) Urban Transport

According to 10 June 2020, 26% of ADB (Asian Development Bank) members had recommended the closing of urban public transit systems and asked people to stay at home and 19% had a legal requirement to close urban public transit systems. About 56% of economies allowed urban public transit systems to continue operating with social distancing guidelines. The number of restrictions on urban public transit across ADB (Asian Development Bank) members peaked between mid-April and mid-May 2020 and has since gradually declined. On 10 June 2020, 19% still required the closure of urban public transit.

Public transit is on the path toward recovery in some cities. On 10 June 2020, public transit ridership was close to the January 2020 baseline trend in Asian cities such as, Ho Chi Minh City; City of Hong Kong, China; Fuji; Hiroshima; Kumamoto; Nagoya; Naha; Niigata; Okayama; Otsu; Sapporo; Sendai; Shizuoka; Takasaki; Toyama; Utsunomiya; and Yokkaichi.

Demand for driving and walking is increasing. The demand for driving and walking is increasing more rapidly than demand for public transit but with some exceptions, where these modes remain well below pre-COVID-19 levels.

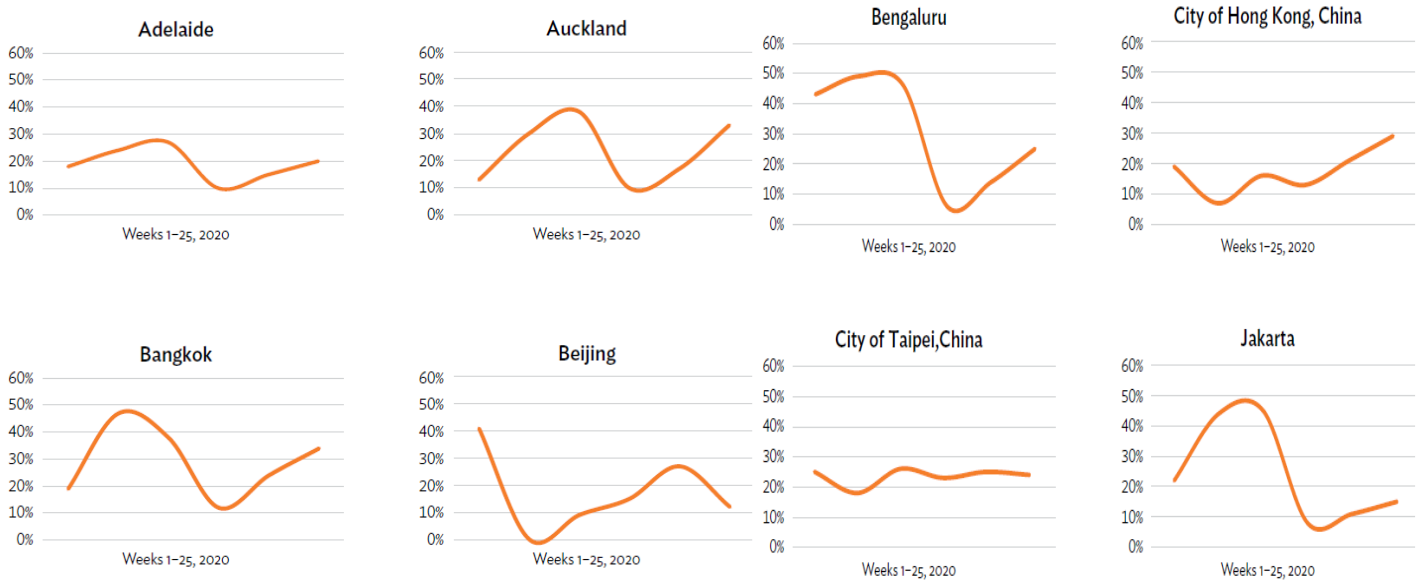


Fig-10 Average Congestion Levels in Selected Asian Cities

Source: TomTom. Traffic Index (accessed 24 June 2020).

2.2.1) Impact on the Environment, Road Safety, and Economy.

2.2.2) Climate Change and Air Pollution.

Before COVID-19, transport contributed to about 24% of carbon emissions directly related to global energy. The lockdowns put in place had a direct impact on CO2 emissions from transport both globally and in rapidly growing Asian economies (Figure 11). The transport sector is estimated to have made the largest contribution to COVID-19-related CO2 emission reductions. The initial impact in the transport sector (in early March 2020) was in Asia and the Pacific region, with other regions contributing significantly in April and May 2020. As lockdowns are relaxed and transport demand increases again, transport-related CO2 emissions are expected to rebound.

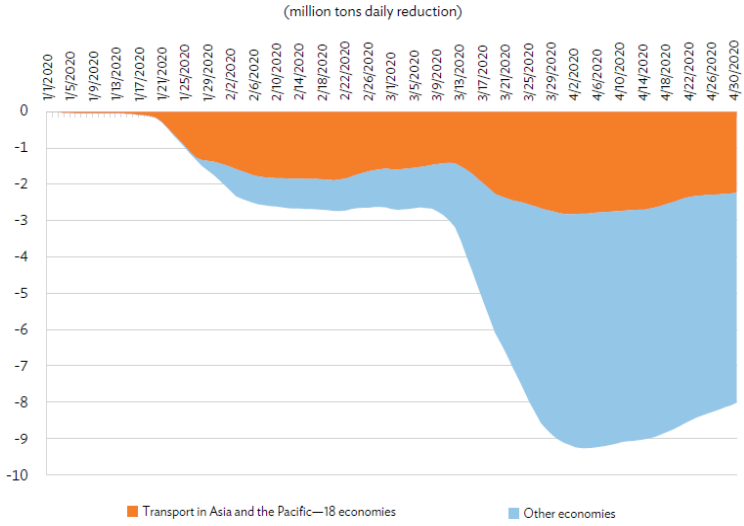


Fig-11 Transport-Related Carbon Dioxide Emissions of Selected Asian Economies and Globally

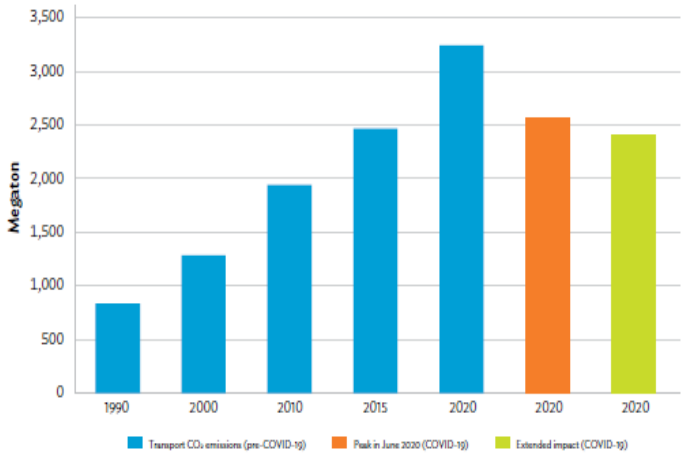


Fig-12 Domestic Transport Emissions of ADB Members in 2020

Changes in Nitrogen Dioxide Compared with Baseline (2015–2019) Levels (%)			
City	1 March 2020	31 March 2020	17 April 2020
Bangkok	(1)	(21)	(22)
Ha Noi	(25)		
Ho Chi Minh City	3	(9)	1
Jakarta	(13)	(10)	(34)
Kuala Lumpur	(6)	(33)	(27)
Metro Manila	(5)	(31)	(34)
Phnom Penh	10	(4)	(6)
Singapore	(16)	(27)	(30)
Vientiane	(5)	0	(9)
Yangon	1	(4)	3

Table-1 Air Quality in Selected Asian Cities, March–April 2020.

2.2.3) Impact on Road Safety

In many countries, fewer people are traveling on roads because of the travel restrictions imposed to control the spread of COVID-19. Lower traffic on the roads is resulting in fewer road crashes. In France, the number of road accident casualties decreased by 40% and the number of seriously injured people reduced by 44% year-on-year in March 2020. Similar trends have been observed in California, where the number of casualties and seriously injured persons related to road accidents dropped by 50%.37 In Asia too, the reduction in road travel has had a positive impact on road safety—but, as the example of Malaysia shows, the lifting of the lockdown will result in a rapid return to business as usual.

2.2.4) Impact on the Economy

Transport is a key sector in most Asia and the Pacific economies. The transport sector's gross value added in ADB (Asian Development Bank) members is estimated to be $2.8 trillion, or about 4% of gross domestic product (GDP). Data from the International Labor Organization indicate that about 157 million people are employed in the transport industry in ADB (Asian Development Bank) members, of which 52% are in road and railway transport services (including pipelines) and 17% are in wholesale and retail trade and automobile repair.

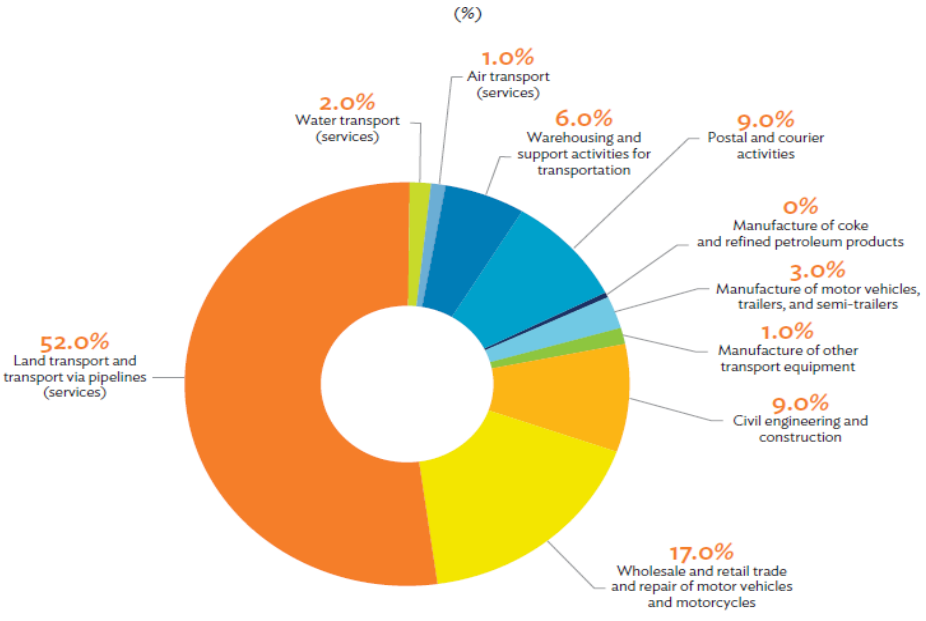


Fig-13 Transport Employment in ADB Members, 2020

ADB = Asian Development Bank.
Source: Authors' analysis based on International Labor Organization data.

2.2.5) Exit Strategy for Lockdown in Asia.

Lifting of restrictions in preparation for a full reopening of economic activities. Thousands of vehicles line up to enter the city of Colombo on 2 June 2020 after the Sri Lankan government removed a 2-month curfew imposed because of the COVID-19 pandemic (photo by M.A. Pushpa Kumara/Asian Development Bank).

The impacts of these lockdowns are being felt at all levels, from individual job security to the global economy and trade. Experts believe there may not be a return to normalcy until a vaccine is found and disseminated widely. The timeline is uncertain and could be more than a year. In the meantime, countries should expect to enter a stage of coexistence with the virus. A pattern of intermittent easing and tightening of restrictions in the coming months may be likely, to keep new infections under control while balancing a rebooted economy.

Economic slows down, sustained remote working, e-learning, and e-commerce are contributing to reduced travel demand. Developing economies, such as the Philippines and Thailand, are showing similar trends, with driving recovering faster than public transit ridership. On the other hand, India is experiencing a much faster recovery of public transit ridership than of driving, most likely because of a relatively higher proportion of captive users. In several developed cities in Europe, extensive government investment in cycling infrastructure has contributed to increased uptake of walking and cycling.

2.2.6) Good Practices for Enhancing the Resilience of Transport Services.

Policy makers, regulators, and especially transport operators can take several measures to enhance the health resilience of transport systems and reduce the likelihood of users becoming infected as lockdowns are eased. This is especially relevant during the phase when COVID-19 infections are declining but the risk of community transmission still exists. Once there is no longer a substantial chance of community transmission, the good practices (under public transit, active transport, aviation, and freight and logistics), especially those on social distancing, are likely to be further relaxed or completely abandoned.

2.2.7) Public Transit

Public transit (including buses) plays an important role, particularly in densely populated cities. It provides the most efficient way of transporting large numbers of passengers in a cost-effective, affordable, and environmentally sustainable manner. Well-planned urban public transport systems also contribute to enhancing the accessibility and vibrancy of the city and quality of life for its residents.

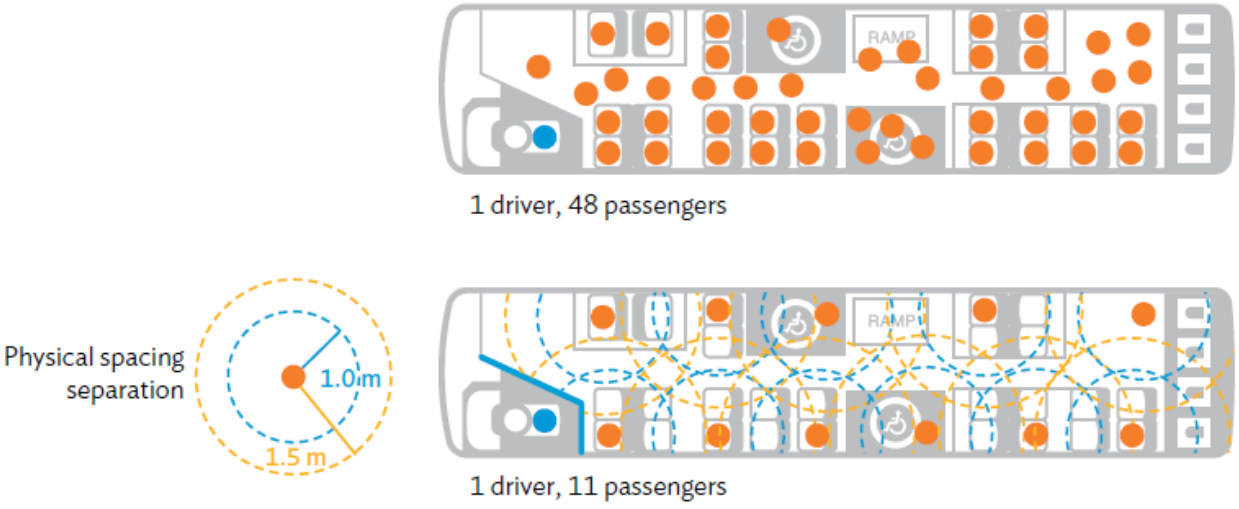


Fig-14 Implications of Safe-Distancing Requirement on Public Transport Capacity

m = meter.

Source: International Transport Forum. 2020. Re-Spacing Our Cities for Resilience. COVID-19 Transport Brief. 3 May.

Demand for urban public transit during the pandemic has been suppressed and is expected to remain below pre-COVID-19 levels if work-from-home trends and e-learning are sustained. The two key challenges are,

(i) tackling capacity challenges on public transport in the context of safe-distancing requirements.

(ii) how best to regain public confidence to encourage a return to public transport.

Additional efforts will be required to reassure public transport users of safety precautions and demonstrate that public transport is clean and safe. Government policies and financial support will be essential to enable public transport operators to remain viable so they can continue to support the movement of passengers and goods to keep the economy going while ensuring longer-term sustainability.

CONCLUSION

In Asian countries as we saw the covid-19 crisis has impacted to the public transport system many policies by government goes is loos of financial support to public users and fluctuation in the economic down government unable to support by financially to moving passengers. Bus transport plays an important rule for public users in highly populated cities.

Many users' treys to use their own vehicles reduced in public transport and in lockdown situation people think better not to travel by any type to transport they are using work from home easiest way to not contact any other person during travel and in covid-19.

In above Asian cities the demand for driving and walking is increasing. The demand for driving and walking is increasing more rapidly than demand for public transit but with some exceptions increase. The number of restrictions on urban public transit across ADB (Asian Development Bank) members peaked between mid-April and mid-May 2020 and has since gradually declined.

Chapter-3
3) COVID-19 redefines public transportation in India.

3.1) Introduction

Ministry of Road Transport and Highways has some restriction on covid-19 for public transport pandemic has disrupted the way people interact with businesses and government, requiring reimagining of modes for interaction of citizens with Governments and businesses. While public transport was suspended across cities worldwide, during February-March, Google mobility report tracking visitors to public transit locations reported a decline of 60-90% traffic. On the same line, as per a World Bank-UITP study on the impact of COVID-19 on public transport in India, the passenger traffic has reduced by 80-100% during the lockdown, whereas the economic fallout to bus operators has been to the tune of INR 69,000 Crores.

Government of India has been proactive in dealing with the continuously evolving situation, from the onset of the pandemic. Several steps have been undertaken by GOI (Government of India) and MORTH (Ministry of Road Transport Highways) to deal with the disruption in goods and people movement. Shared public transport operators like cab aggregators, taxi associations, transport associations need to lead the effort in deploying technology to safeguard passengers and designing innovative personal hygiene protocols to prevent spread of the virus. Similarly, the hospitality industry specifically the HoReCa (Hotels-Restaurants-Cafeteria) segment will have to ensure similar sanitation arrangements for their continued operations recreating demand for individual travel and thereby the revival of public transport.

3.2) Characteristics of Sample set.

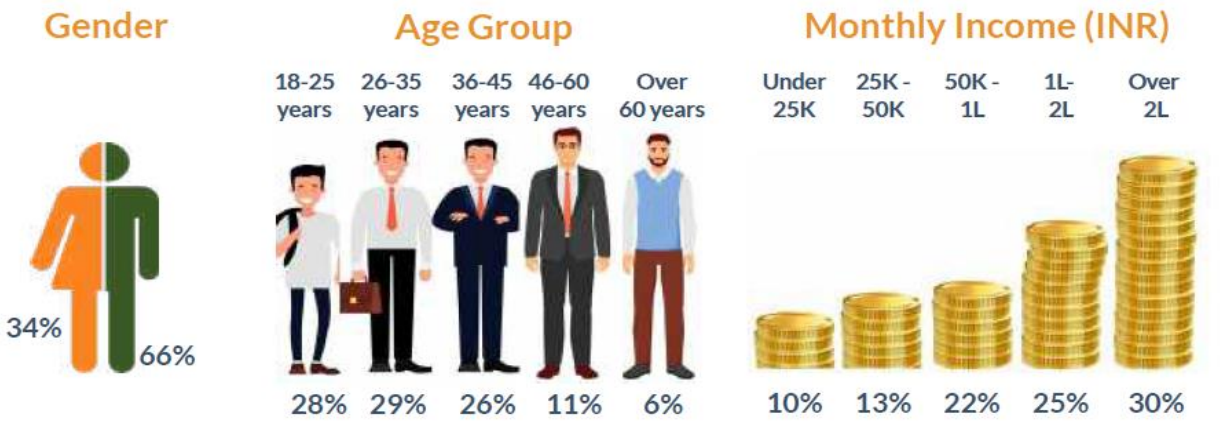


Fig-15 ASSOCHAM and Primus Partners, through this publication, public transport ecosystem.

The COVID-19 pandemic has significantly impacted everyone and almost every aspect of life. The world is dealing with challenges which were hitherto unknown and the impact of this is visible on the global economy. The Transport sector, especially public transport, has been impacted significantly by the pandemic.

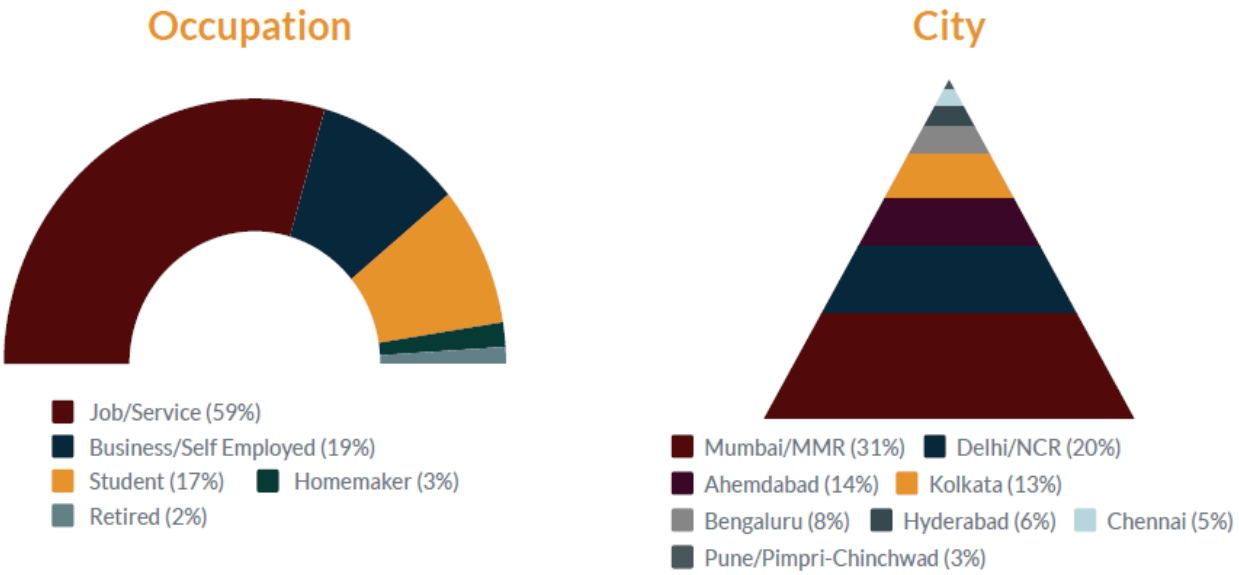


Fig-16 percentile ratio over all categories of Indian cities.

3.3) Public Transport hits a roadblock post-lockdown.

Many more people prefer to use their own vehicles post lockdown, it may lead to traffic congestion in cities with the rapid growth of urbanization in India, public transport has become an intrinsic part of city life for intra and intercity commute. Public transportation is the primary mode of transit in large cities and urban regions in India.

App-based Cabs, more and more people in urban areas are finding usage of public transport reliable, convenient, comfortable, and safe. Based on the survey conducted by us, we found that before the lockdown, 55% of the people in these cities or metropolitan regions were using public transport. Public transport was preferred by more than 2/3 (>67%) of the people in two of the most densely populated cities - Kolkata and Mumbai. It was less prevalent in cities like Pune and Ahmedabad.

However, the COVID-19 pandemic has significantly changed this as we have seen from our survey in the eight cities.

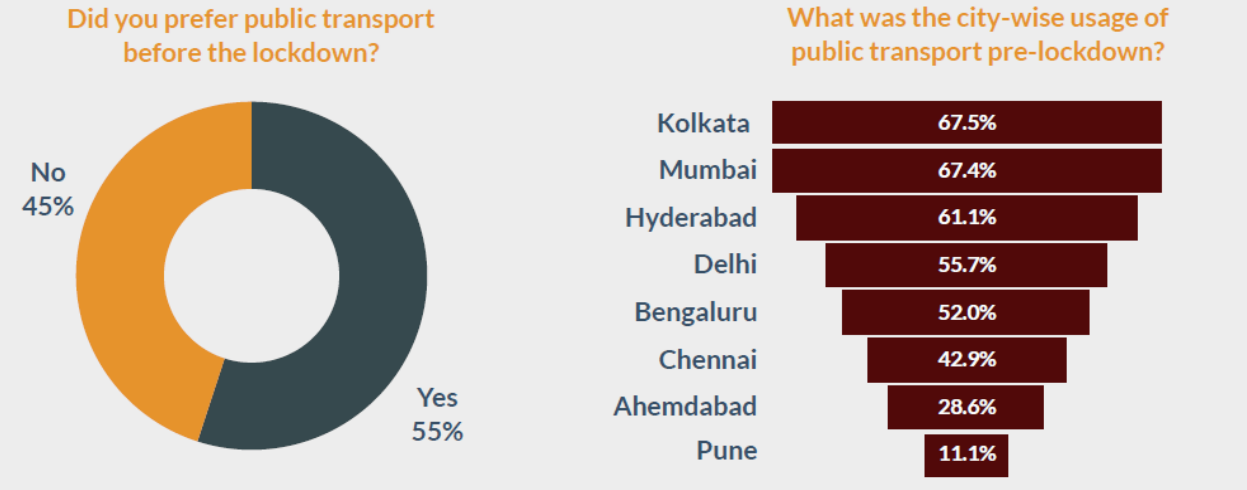


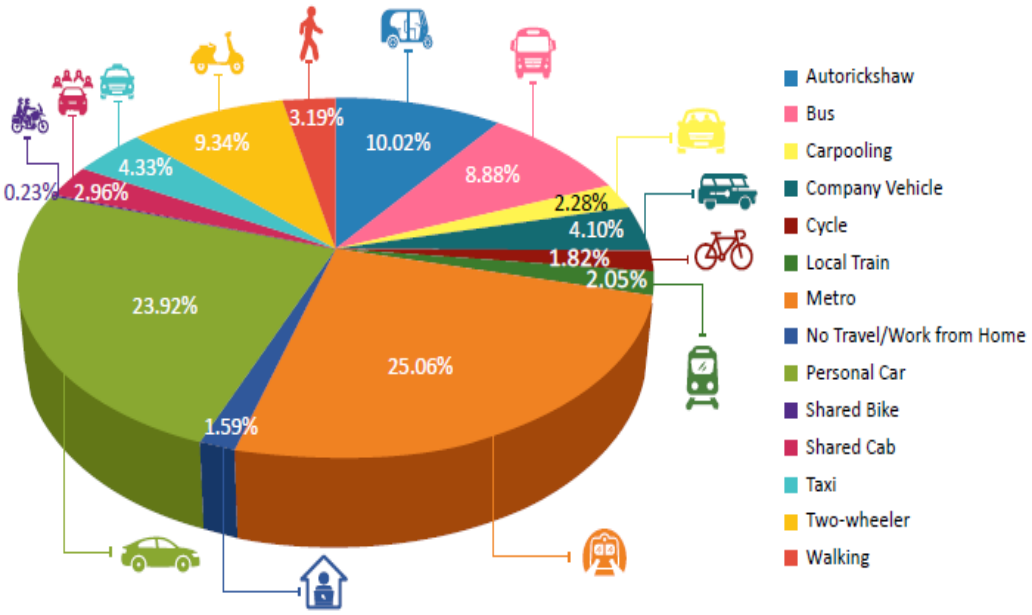
Fig- 17 Preference for Transport before Lockdown and Preference for Transport before Lockdown.

3.3.1) Passenger Travel Demand.

3.3.2) Share of Transport Modes Before COVID-19.

As per the survey, the share of different primary modes of travel before COVID-19 is captured in (Figure 18). The stated mode choice survey found high usage of private cars with 23 per cent of respondents using their own cars for work trips. Public transport was well represented, as metro and bus services were availed by 25 per cent and 9 per cent of the respondents, respectively. The intermediate public transport (IPT) modes, such as private taxis and autorickshaws constituted about 15 per cent of the sample. The high usage of public transport in the sample despite the availability of private cars and high-income levels in the sample suggests the prevalence of choice users.

Several respondents walked to work as well. Only 2 per cent of respondents reported that they cycled to work despite more respondents owning at least one bicycle. Distance between home and workplace might hinder cycling to work but this could also be attributed to the lack of cycling infrastructure in Indian cities. Two-wheelers were also represented in the sample with 9 per cent of respondents choosing this mode.



Mode of share mobility before covid-19

Fig-18 Share of different transport modes used by respondents pre COVID-19 (work trips)

3.3.3) India mobility modal shift post covid-19 crisis.

Respondents were asked if the COVID-19 crisis would influence their choice of transport modes. Most respondents (65 per cent) said, there would be no change in their choice. This was expected, as a large proportion of respondents used private cars and non-motorized transport (NMT) for their commute, anyway. Only 9 per cent responded that their choice would be altered by the crisis. The rest of the sample (26 per cent) responded with maybe – this could be a result of prevailing uncertainty at the time of filling the questionnaire. Overall, the results suggest that the transportation demand could be significantly altered with almost 35 per cent of the sample potentially switching to different modes.

To understand the nature of the shift, respondents were asked about their choice of transport post the COVID-19 crisis. Out of the respondents who said, maybe, 66 per cent provided a mode choice for the post- COVID-19 scenario, which was different from their initial choice of transport mode. These responses were included while estimating the modal shift.

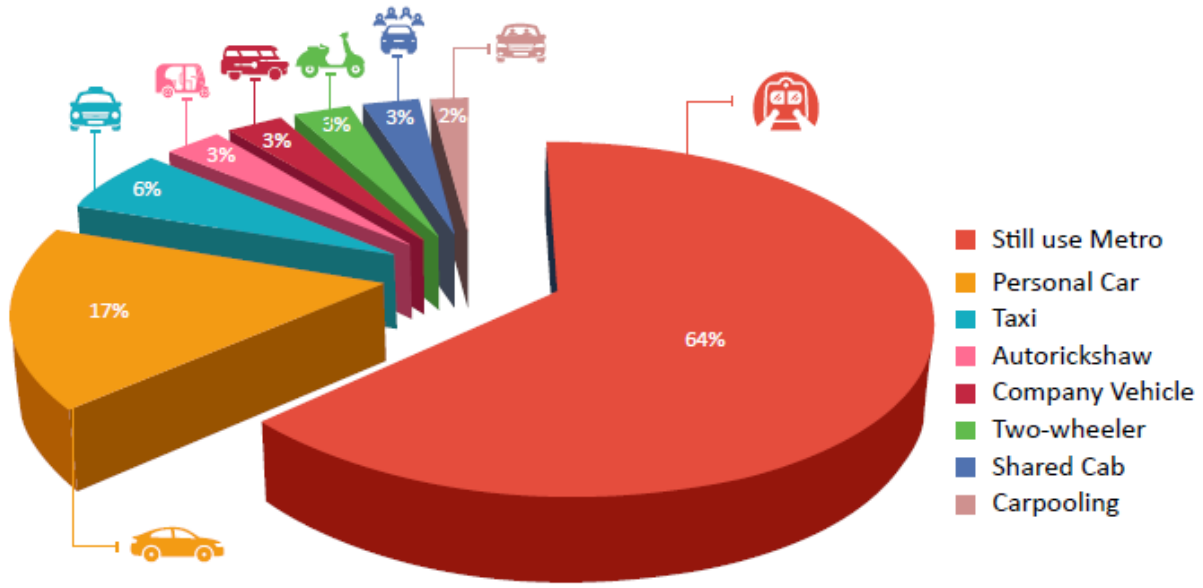


Fig-19 Stated post-COVID-19 modal choice of initial metro users (work trips).

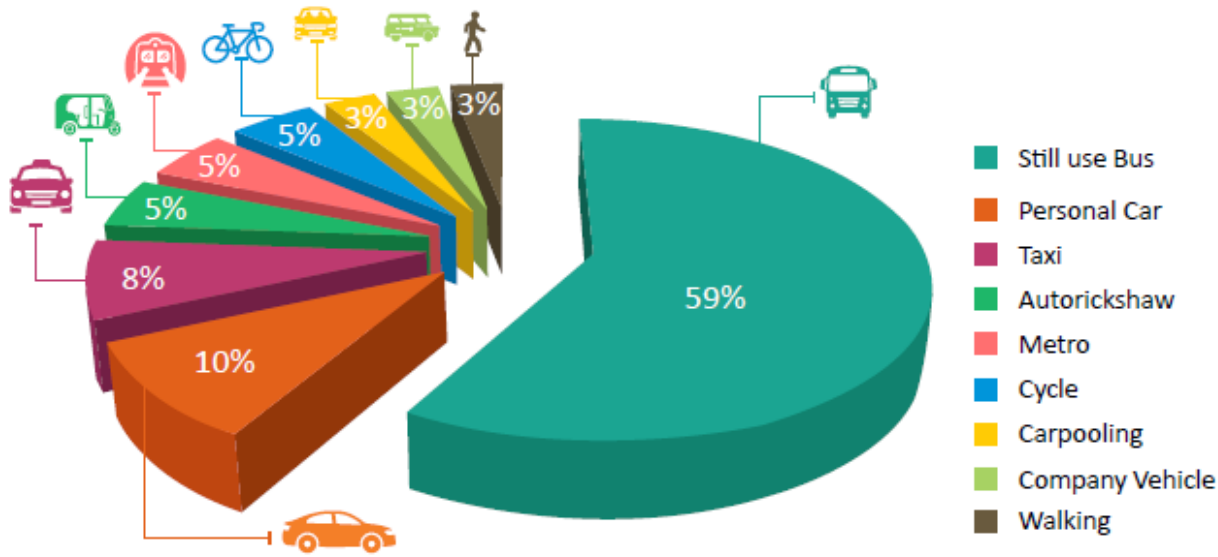
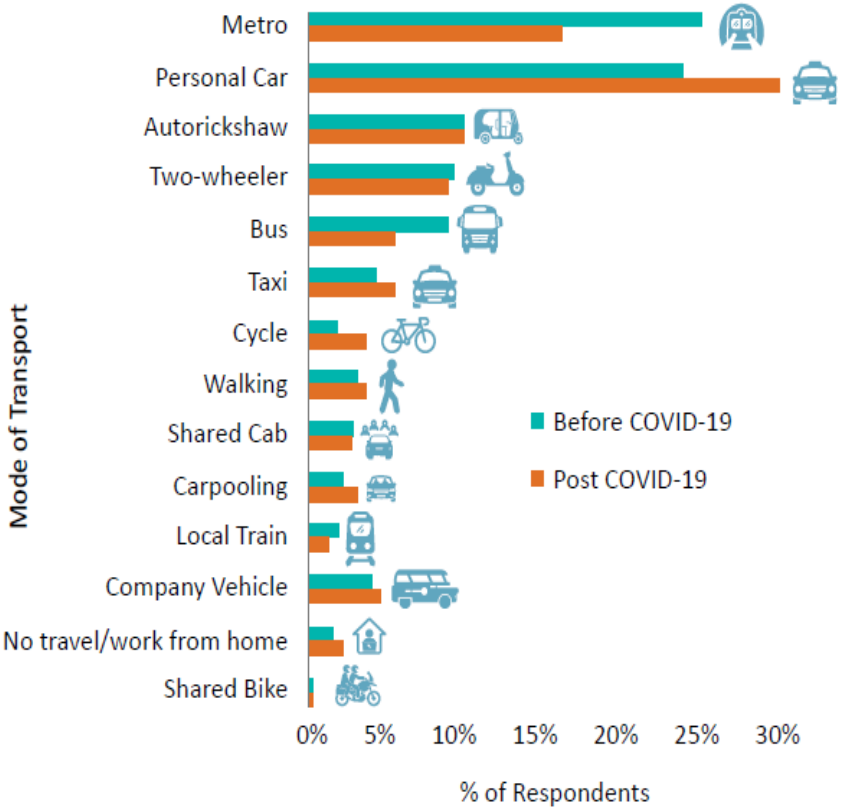


Fig-20 Stated post-COVID-19 modal choice of initial bus users (work trips).

In above figure shows that 41 per cent of initial bus users stated that they would shift to other modes. Like metro services, the most common change was a shift towards private vehicles and intermediate public transport. Additionally, some bus users stated, they would shift to non-motorized modes such as cycling and walking. The decrease was also witnessed in the use of local trains, mostly by residents in Mumbai.

3..3.4) Overall stated modal share for the sample pre and post COVID-19.

The largest decrease was seen in the modal share of metro services (9 per cent) followed by buses (4 per cent), and local trains (1 per cent). The decrease in these modes is compensated by a significant increase in the private modes of travel. The share of private cars and two wheelers increased by about 10 per cent. The share of private taxis also increased by about 2 per cent. The share of shared taxis decreased by a margin while the share of carpooling increased. The use of nonmotorized transport showed an increase with the modal share of cycling and walking (combined) increasing by around 3 per cent. Some respondents also stated that they would not travel to work post COVID-19 and prefer working from home, instead.



Graph-3 Modal share in pre- and post-COVID-19 scenario for the sample.

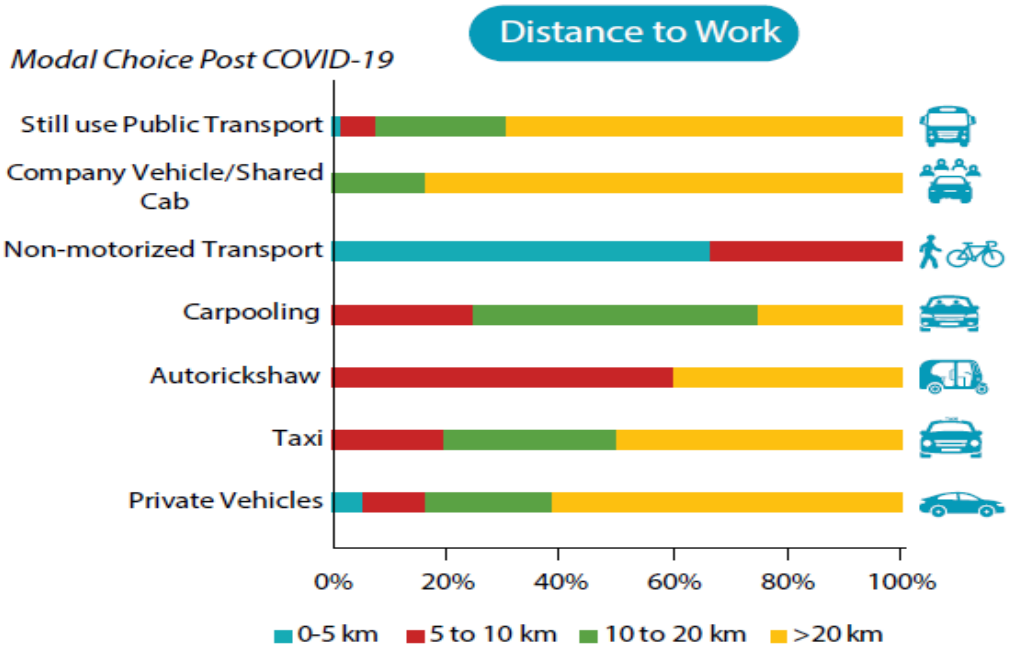
3.3.5) Sample Characteristics and changes in Modal Shift.

The modal choice affected the characteristics of the respondents too. The post-COVID-19 modal choice of public transport users was analyzed separately in terms of distance (from home to work), and household income.

3.3.6) Distance travelled.

All initial public transport users, who planned to switch to NMT, travelled less than 10 km to reach their workplace, with the majority travelling less than 5 km. A significant number of respondents shifting to personal vehicles and IPT also travelled less than 10 km. There is a possibility that these users could be nudged to shift to NMT if the right infrastructure were available. Most respondents, who wished to continue using public transport travelled more than 20 km. Shared cabs were also mostly opted for by those people who travelled more than 20 km, there by

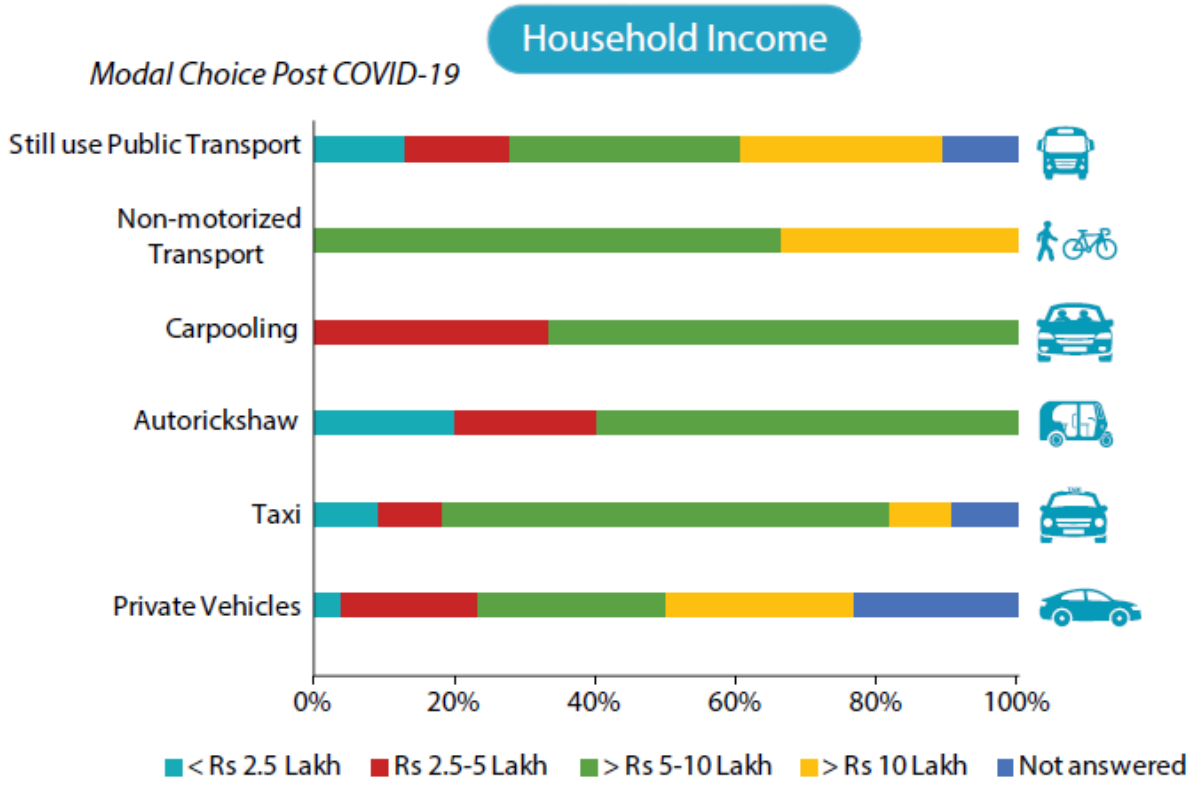
suggesting that distance does influence a commuter's choice between private taxis and shared modes.



Graph-4 Distance to work and post-COVID-19 modal choice of initial public transport users.

3.3.7) Household income:

People shifting to private vehicles included both high- and lower-income respondents; lower-income respondents mostly opted for two-wheelers. One surprising finding was that people shifting to NMT also belonged to higher income groups. This suggests that there is a willingness in people to shift to NMT irrespective of their income.



Graph-5 Household income and post-COVID-19 modal choice of initial public transport users.

Conclusion

India in covid-19 facing the problems like distance learning activities in the sense many people lost their jobs and students are struck to homes cannot get all facilities for learning from home. In lockdown trains, buses, taxis, air transport was closed to control the system and the people in India is huge task to government. Due to lockdown in India people not getting food on time so because of hungry any people die.

India stands second in list for covid-19 cases in world all borders where closed for the passengers who coming from other countries rapid in covid-19 cases. Private car and motor bike are used for home to work some people refers the remote working it is easy for employment to work from home then gradually employment rate is down day by day.

Chapter-4

4) Covid-19 PIARC'S responses on roads and transport sectors.

4.1) About PIARC

The PIARC is a world road association this network is stablished in 1909 at the motor age as a non-profit organization. This network works worldwide over 100 years, the association continues to foster to facilitate the global discussion and knowledge sharing on roads and transport sectors. The association will be the world leader in the exchange of knowledge on roads and transport policy practice within an integrated sustainable transport industry. It also provides an overview of the policies and trends that affect all road users, the first international road congress held in Paris when it was the called the **Permanent International Association of Road Congresses** (PIARC).

The Road Engineering Association of Asia and Australasia was established in 1973 as a regional body to promote and advance the science and practice of road engineering and related professions. The Association was granted consultative status by the United Nations Economic and Social Council in 1970. The current organizational structure will be described below.

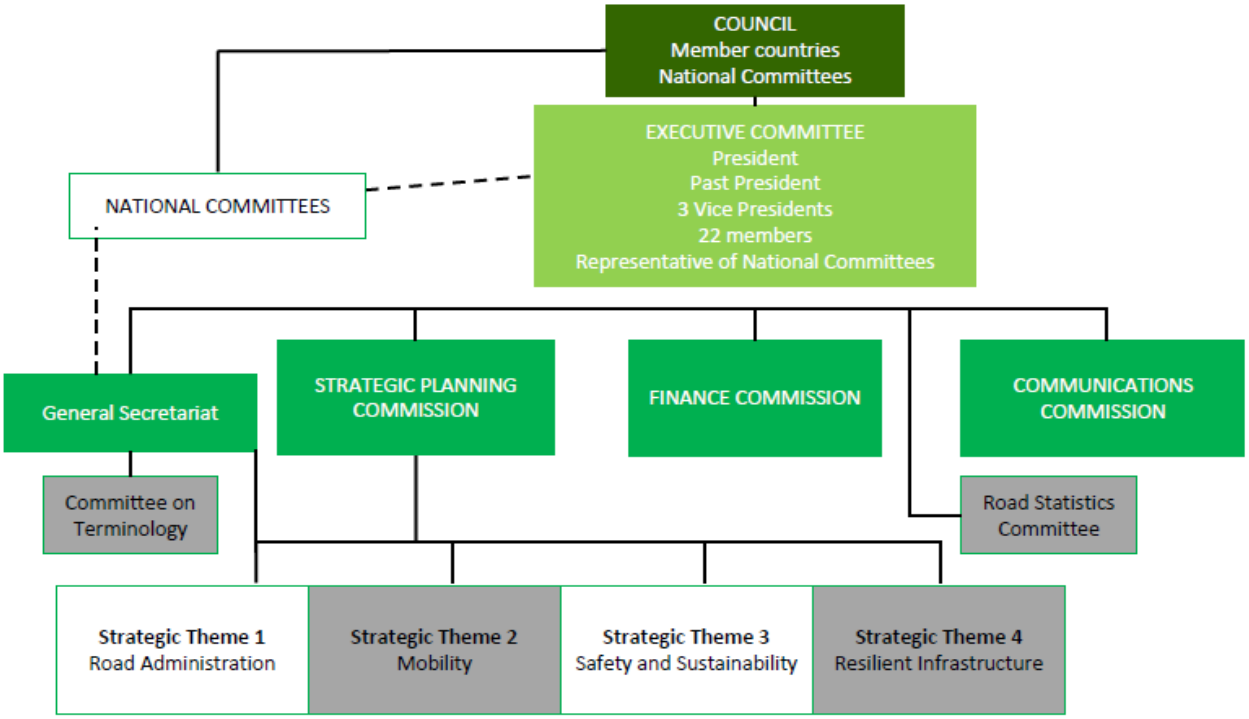


Fig-21 PIARC working process flowchart of 2021.

4.2) The Roads and Transport sector.

The roads and transport sector the public and private organization within it have been very strongly impacted by covi-19. However, it has a vital role in keeping essential goods and workers moving, maintaining as much as possible the integrity of the supply chain, and ensuring that public heath, law enforcement and other emergency response professional can do their jobs effectively. Road transport is an essential service. The sector will have a vital role in the recovery too, especially if government prioritize infrastructure investment as an economic stimulus. With air transport severely hampered by the pandemic, surface transportation has become even more important in maintain connectivity and providing a lifeline to even the most remote places.

Globally, land transport is estimated to account for 60 million direct jobs 2% of total employment. Indirect employment in the wider supply chain is even greater and land transport provide physical mobility which support employment in multiple other sectors. Direct employment in public agencies in the land transport sector is estimated at around 1.3 million at local, regional and national level. The covid-19 crisis has brought major changes to these agencies their supply chain, related workers, in following categories.

- The demand for mobility and in some cases transport capacity, has seen a significant decrease, with contraction in travel varying across modes models and networks.
- Border closures inspection and movement restriction have been implemented between nation regions and cities.
- The continued access to and operation of transport infrastructure and services has been critical to keep the supply of essential worker and goods moving.
- While in some countries construction, rehabilitation and maintenance work on the road , transport infrastructure and assets and other related contracts, have been suspended, slowed down or rescheduled in order in other countries construction activities have been declared essential and not only continued but accelerated to reduced traffic.
- Road operator in general experienced significant reduction in revenues either as a direct impact of the reduction in daily traffic or due to countries suspending toll collection during the heigh of the pandemic.

4.2.1) PIARC point of view of the covid-19 pandemic

4.2.2) Global incidence of covid-19.

Throughout all over the world as of **2nd December 2020**, reported COVID-19 cases globally topped 64.5 million and almost 1.5 million were reported to have died. Figure 22 below illustrate key trends across regions.

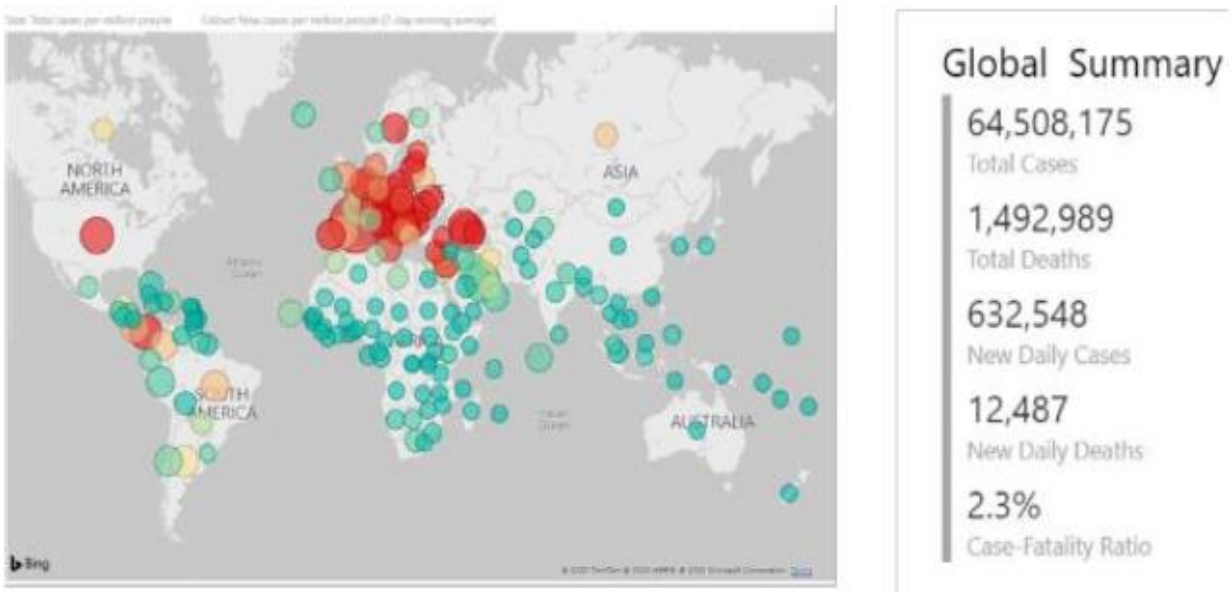


Fig-22 Incidence of COVID-19 across the World (2nd December)

Regions	Total Cases	Total Deaths	Total Cases per million people	Total Deaths per million people
South America	11,279,462	327,883	26,119	759
North America	16,224,888	410,255	27,675	700
Europe	17,729,720	405,767	23,697	542
Middle East	3,368,129	79,323	12,905	304
South Asia	10,685,923	155,275	5,882	85
Africa	2,201,303	52,581	1,643	39
Asia-Pacific	3,018,007	61,890	1,178	24

Table-2 State region wise case and death recorded during covid-19 crisis.

Fig-23 Increase of covid-19 cases and deaths by monthly in all continents.

4.2.3) Impact of Mobility

Lockdowns stay at home orders and restrictions on activities across the World have inevitably affected personal mobility and, by implication, access to various destinations and services. According to mobile data collected by Google and Apple, non-residential destinations have seen falls more than 60 to 90 per cent at maximum restrictions. Mobility levels have partially recovered in some countries as facilities have re-opened but are still around 20 to 40 per cent below pre lockdown levels. Renewed falls in mobility are also evidenced in some cities in late 2020 as lockdowns are reimposed to handle second waves of infection. It is likely to be some time before activity returns fully, impacted by the cessation of businesses and jobs, the substitution of some activities with online services, and the short-term repatriation of migrant workers to their home countries.

Congestion levels have fallen sharply in cities across the World, air quality has improved, carbon emissions have fallen, noise levels have reduced some citizens and residents perceive an improved quality of life in working from home and interacting in their local neigh bour hoods rather than commuting to a city center office. There is also some evidence that road accidents, which kill around 1.2 million people a year globally, may have fallen in line with reductions in traffic levels, but this is not universal and the impact on accident severity may be less positive as motorists drive faster on quieter roads resulting in higher impact collisions.

4.3) National and localized lockdowns, curfews and other restrictions have had a direct impact on mobility which remains below pre-pandemic levels.

4.3.1) Framework for the key stages of the pandemic.

The focus of most transport professionals has been on tracking, managing, and recording the consequences of what the International Monetary Fund (IMF) has called "The Great Lockdown," attention has increasingly turned to sustainable exit strategies and dividing actions in response to the COVID-19 pandemic into different stages. These need to be designed to not only release people from isolation, but carefully restart economic and social activity and pave the way for a viable and sustainable recovery into 2021 and beyond.

At the time of national lockdown measures have largely ended in most part of the World, changing at different times and with varying profiles in different places. Whilst a "second wave" is evident in some regions, for example Europe, in other continents, for example East Asia, infections have declined considerably.

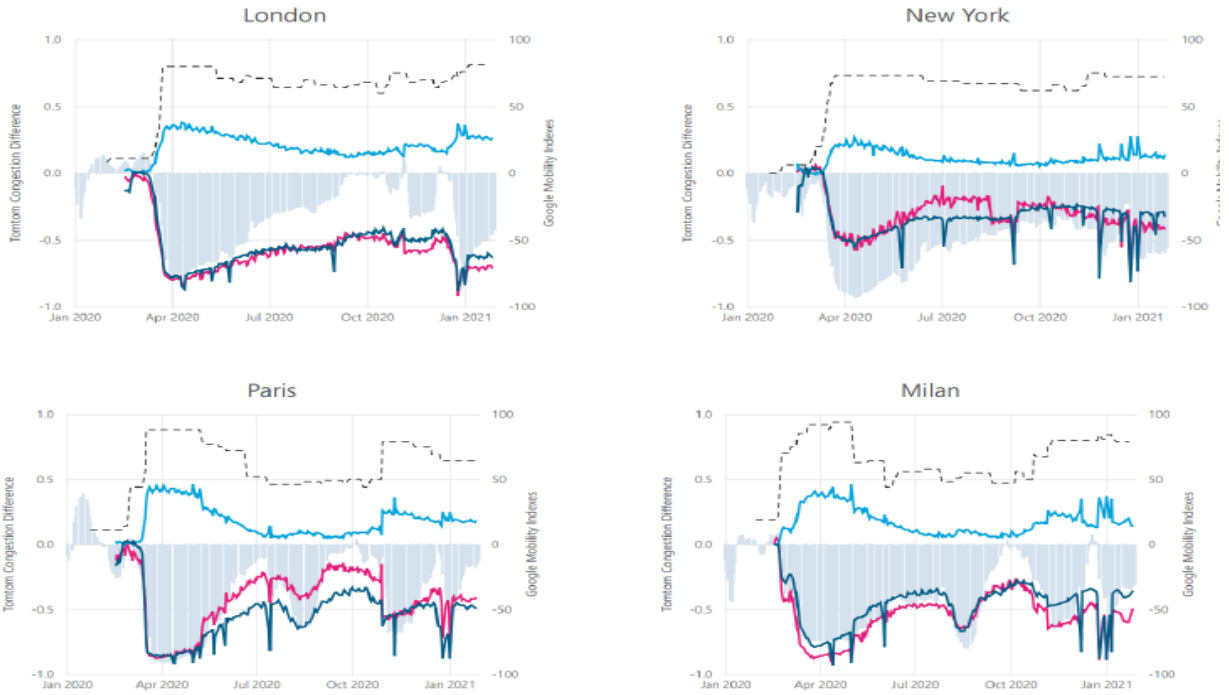


Fig-24 Nationalized curfew which has direct impact on mobility below average during pandemic.

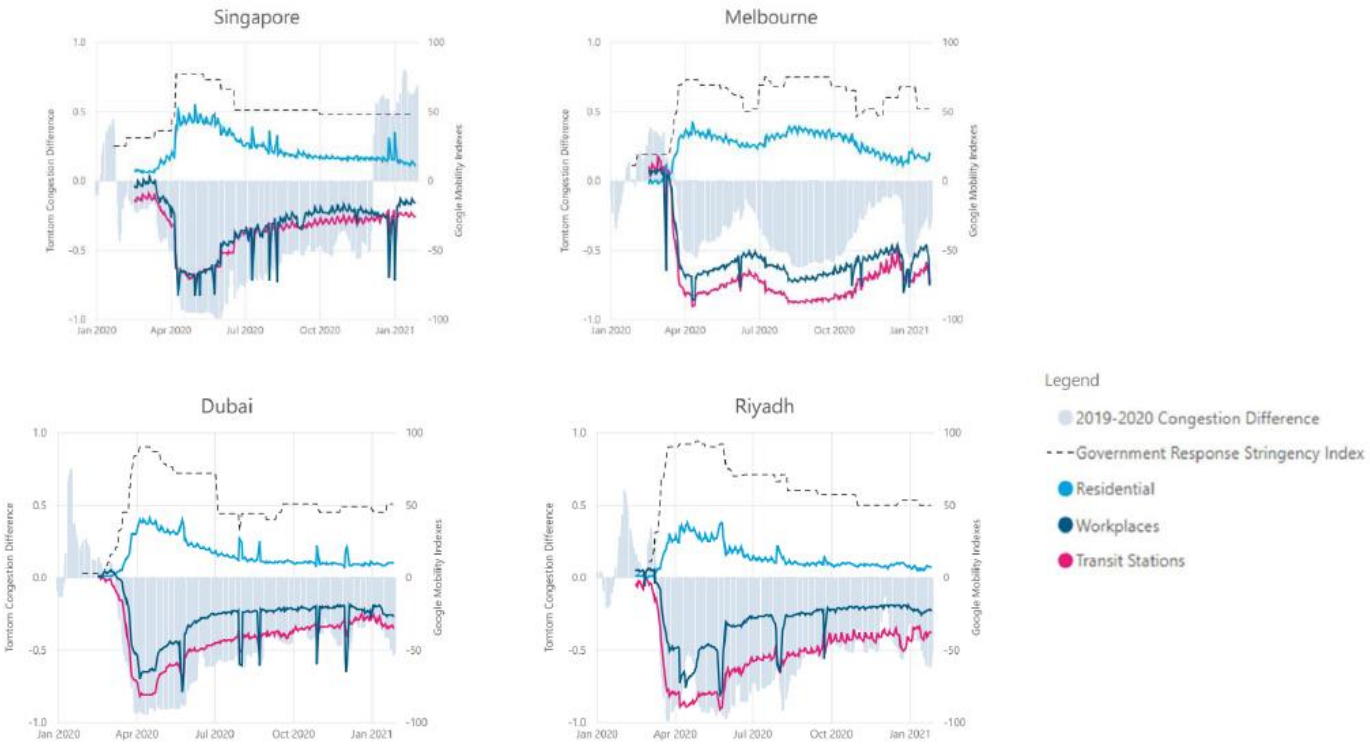


Fig-25 Nationalized curfew which has direct impact on mobility,
to move from residential to workplaces its in below average during pandemic.

To assist in this process, the PIARC COVID-19 Response Team has made reference to a three phases model called Reopen – Recover – Reimagine. The model includes:

- Short-term **Reopening** from lockdowns, based on social distancing, face masks and other personal protection and greater intelligence and experience in tracking and managing the virus, with risks carefully managed until a vaccine and more effective therapeutic treatments are available. This release period is evident in some regions and countries in late 2020, but with the very real prospect of renewed lockdowns in others in response to second or third waves as infection rates increase again. Life is unlikely to get back to "normal" until well into 2021.
- Medium-term **Recovery** of national and local economies, supported as Governments and the private sector assess immediate needs and launch various initiatives for rehabilitating businesses, creating new employment, and rebuilding the sectors and localities worst impacted. This period is expected to last into 2021 and likely well beyond, including accelerated infrastructure delivery, technology research and other tools of economic stimulus and industrial strategy.

• Long-term **Reimagining** of how the transport system will meet future needs, reflecting impacts, challenges, and opportunities of COVID-19 such as economy, social inclusion, Sustainable Development Goals, urban vs. rural connectivity, climate emergency and net zero programmed, and consideration of measures looking to transform and future-proof transport infrastructure and services towards 2025 and beyond. This period has already started.

The framework has a strong emphasis on the application of data and evidence, evaluation and rapidly learning lessons to shape decision-making. Data, testing, learning and knowledge sharing will be critical, most obviously in controlling the spread of COVID-19 in the transition from lockdown to successful and permanent reopening.

4.3.2) Overall PIARC covid-19 response.

The COVID-19 pandemic has caused severe disruption to individuals' lives, to organizations and to the delivery of goods and services across the World. Like public agencies and organizations in multiple sectors, PIARC members have been affected as well and applied various actions to respond. Many PIARC members have also been thrust to the forefront of pandemic response, as governments look to them to maintain critical lines of supply and to keep essential workers and goods moving while at the same time avoiding collapse in road and transport management. In this context, roads and transport, which are critical to the economic vitality of a country, have to remain operational.

Effective management of emergency situations resulting from large, multiple and complex hazards that may disrupt road operations requires cooperation and coordination among several stakeholders including government agencies, road operators, road construction and maintenance companies, emergency services and road users. Some existing PIARC reports are very relevant in the current situation and they are available for free from PIARC's website. With the pandemic and its impacts expected to last for some time, the PIARC General Secretariat, with approval from the President and Chair of the Strategic Planning Commission, moved quickly in March to establish a formal PIARC COVID-19 Response Team, with a major objective to ensure the rapid sharing of knowledge and practice between PIARC members in impacts of, and responses to, the pandemic and the associated economic and social crisis. The work of the Response Team forms the main focus of this Report and is described in further detail below. The importance

attached to the Team is indicated by the fact that it is chaired by the PIARC Secretary General and has delegated mandate and authority from PIARC to make decisions rapidly on key activities and outputs.

The full impacts of COVID-19 on mobility, demand for transport, operational and environmental performance of the roads and transport sector by PIARC.

City	Tomtom Congestion Index			Google Mobility Workplaces			Google Mobility Public Transport		
	Lowest	Date	Current (26 Nov)	Lowest	Date	Current (26 Nov)	Lowest	Date	Current (26 Nov)
Athens	-0.79	20 Aug	-0.68	-62	26 Mar	-44	-78	26 Mar	-64
Bologna	-0.69	19 Mar	-0.38	-74	26 Mar	-26	-85	26 Mar	-49
Dubai	-0.93	02 Apr	-0.4	-65	09 Apr	-20	-81	09 Apr	-32
Johannesburg	-0.72	09 Apr	-0.19	-78	09 Apr	-21	-81	09 Apr	-19
London	-0.76	02 Apr	-0.29	-78	02 Apr	-50	-80	02 Apr	-59
Madrid	-0.86	19 Mar	-0.14	-92	09 Apr	-29	-92	09 Apr	-38
Manchester	-0.78	09 Apr	-0.44	-69	02 Apr	-38	-79	02 Apr	-57
Melbourne	-0.64	20 Aug	-0.14	-72	06 Aug	-52	-88	06 Aug	-68
Mexico City	-0.86	21 May	-0.41	-73	09 Apr	-39	-69	09 Apr	-41
Milano	-0.81	20 Aug	-0.65	-79	26 Mar	-43	-88	26 Mar	-60
Montreal	-0.86	02 Apr	-0.25	-74	09 Apr	-42	-78	09 Apr	-54
New York	-0.94	09 Apr	-0.58	-77	26 Nov	-77	-73	09 Apr	-68
Paris	-0.89	26 Mar	-0.53	-86	26 Mar	-49	-87	26 Mar	-51
Rome	-0.8	16 Apr	-0.32	-76	26 Mar	-33	-86	26 Mar	-46
Santiago	-0.81	21 May	-0.3	-83	21 May	-27	-82	21 May	-31
Sao Paulo	-0.8	09 Apr	-0.37	-59	26 Mar	-18	-66	26 Mar	-22
Singapore	-1	28 May	-0.55	-83	07 May	-23	-72	07 May	-27
Tokyo	-0.55	07 May	-0.06	-70	23 Jul	-18	-58	23 Apr	-27
Toronto	-0.84	09 Apr	-0.56	-70	09 Apr	-48	-75	16 Apr	-60
Wuhan	-0.96	26 Mar	-0.11	0	#N/A	0	0	#N/A	0

Table-3 changes in Key Mobility and Congestion Indices in Selected Global Cities during COVID-19 Pandemic.

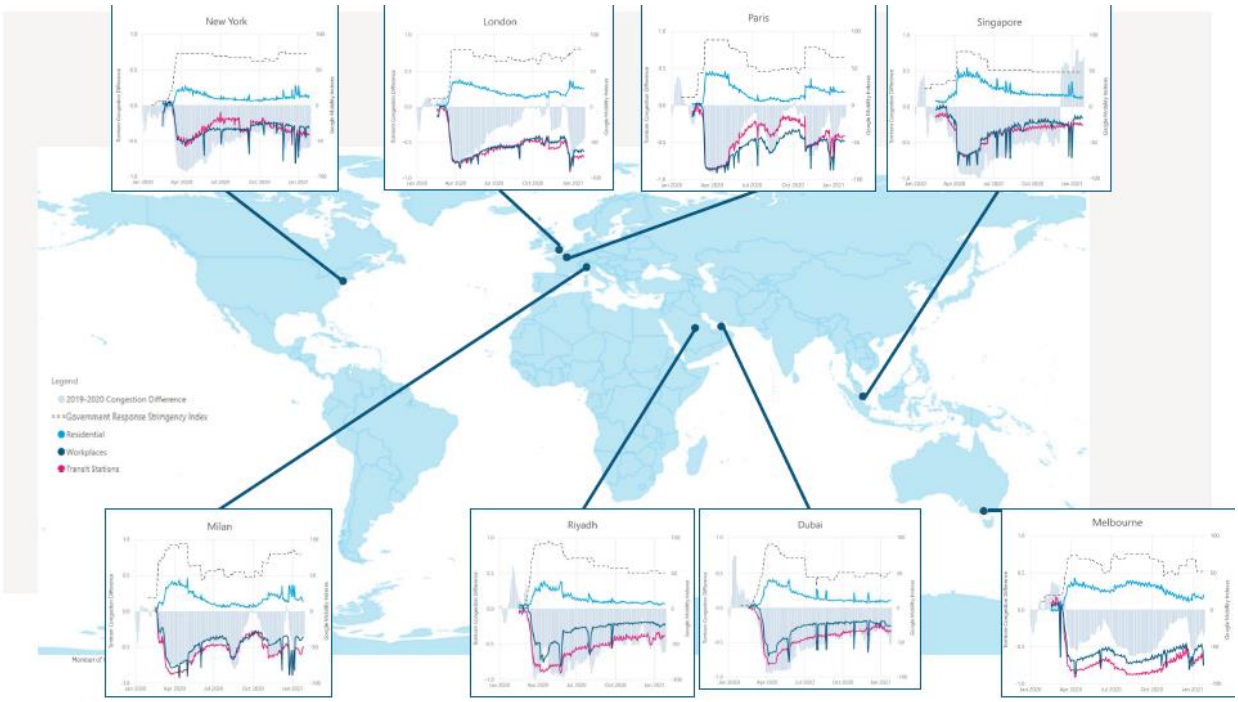


Fig-26 Changes in Key Mobility and Congestion Indices in Selected Global Cities during COVID-19 Pandemic.

4.3.3) Maintaining Road Inspection and Surveillance.

Organizations' roles of road inspection and surveillance, whether as a standing function or for individual projects, have been successfully maintained. For example, engineers have been permanently connected during the pandemic to their contractors and inspectors, as well as the personnel who collaborate with them, and have been able to reduce their physical site visits to the minimum necessary whilst maintaining activity. Agencies have also issued mobility permits, or equivalent, to justify essential travel during the pandemic, including securing the necessary clearances from other authorities.

4.3.4) Maintaining Traffic Control.

The speed and accuracy with which data on the traffic volumes, composition and network conditions is obtained is an instrument of great importance for the authorities responsible for road network management, public health, and economic matters.

Traffic Control Centers have been developed over many years as key points of collecting, analyzing and disseminating such data. One of their most important tasks regarding COVID-19 is the development of tools to understand mobility from a variety of sources to provide.

- Support for monitoring the evolution of pandemic.
- Evaluation of the effectiveness of, and public compliance with, mobility restriction measures adopted by Government.
- Monitoring and decision-making during re-opening after lockdown

Fig-27 Utilizing Traffic Control Centers During the Pandemic.

SOURCE: Figure from Dominique Verlaine (Belgium) presentation at PIARC Webinar 17 April 2020

periods, as well as renewed local lockdowns or travel restrictions where relevant.

- Development of dynamic dashboards and modelling techniques that allow network and service adaptation to changing stages of the pandemic; and
- Monitoring of controls and law enforcement activity to ensure road safety.

4.3.5) Technology and road network operations.

General Overview on Road Network Operations During the Pandemic.

Intelligent Transportation Systems (ITS) have garnered popularity, due to considerable advancements in information technology, the development of mobile and smart devices, and improvement in sensing technologies. ITS and new ways of managing road network operations have transformed the policies and practices of road agencies and operators.

The implementation of road based ITS has resulted in the enhancement of road operations, better surveillance of the road network and drastically improved safety for road users, together with renewed capacity to better understand road users' expectations and needs. Crucially in the context of this Report, the deployment of ITS has provided more effective response to events management, and reaction to disaster and extraordinary conditions.

While the world deals with the combined crisis associated with the global pandemic and associated economic downturn, the imminent emergence of a new mobility ecosystem appears in doubt. However, whilst there are many uncertainties, there is an opportunity for road networks to develop new ways of undertaking core activities, and this involves the uptake of ITS technologies.

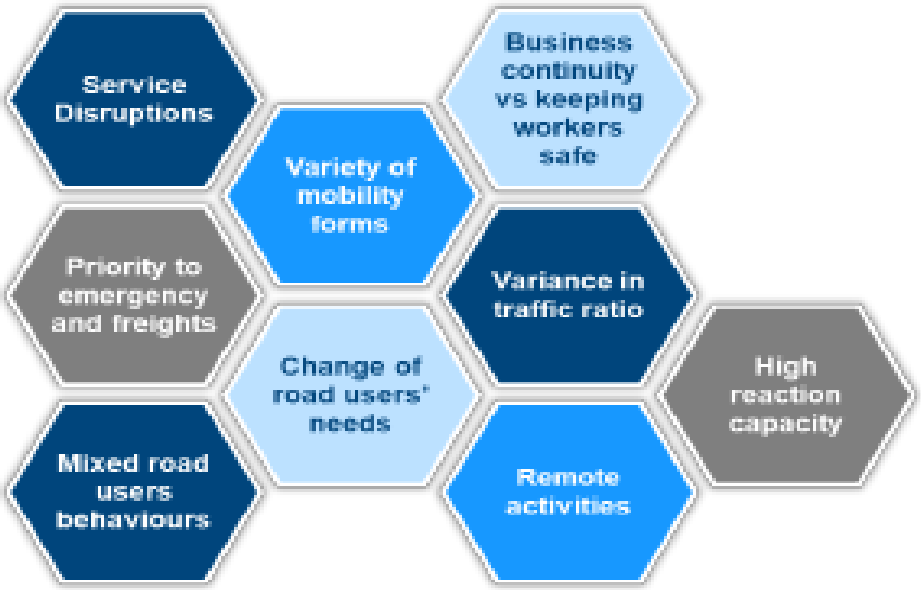


Fig-28 Dimensions of COVID-19 and Road Network Operations.
Source: Figure from Valentina Galasso (Italy) presentation at PIARC webinar 29 July 2020

Conclusion

PIARC is one of the worlds best in road transport sector provide all needs to users updating regular challenges to solve the issue the road problems in technical and professional (experts) dealing with transport large scale of industry. PIRAC is a World Road Association the work on covid-19 crisis to transport is handled in responsible way of dealing with problem to road.

PIARC during the pandemic smart intelligence Transport system (ITS) improves the roads network for mobile dives and advise for economy to improve in the world-wide response Team, with a major objective to ensure the rapid sharing of knowledge and practice between PIARC members in impacts of, and responses to, the pandemic and the associated economic and social crisis.

Chapter-5

5) Road Safety Measures for Users.

Road safety refers to the methods and measures used to prevent road users from being killed or seriously injured. Typical road users include pedestrians, cyclists, motorists, vehicle passengers, horse riders, and passengers of on-road public transport (mainly buses and trams). Best-practice road safety strategies focus upon the prevention of serious injury and death crashes despite human fallibility. Safe road design is now about providing a road environment which ensures vehicle speeds will be within the human tolerances for serious injury and death wherever conflict points exist. Furthermore, the highest possible degree of safety shall be ensured when transporting goods by road.

It is of vital importance to monitor and validate the road transportation safety, including comprehensive checks on drivers, vehicles, and safety processes. The basic strategy of a Safe System approach is to ensure that in the event of a crash, the impact energies remain below the threshold likely to produce either death or serious injury. This threshold will vary from crash scenario to crash scenario, depending upon the level of protection offered to the road users involved.

As sustainable solutions for classes of road safety have not been identified, particularly low-traffic rural and remote roads, a hierarchy of control should be applied, similar to classifications used to improve occupational safety and health. At the highest level is sustainable prevention of serious injury and death crashes, with sustainable requiring all key result areas to be considered. At the second level is real-time risk reduction, which involves providing users at severe risk with a specific warning to enable them to take mitigating action. The third level is about reducing the crash risk which involves applying the road-design standards, improving driver behavior and enforcement.

5.1) Human Factor

The road user is a key contributing factor in most accidents Considering behavior improvement as a main goal in road safety Road users' education is a key issue when defining implementing and evaluating road safety strategies and policies**.**

The road transport system can be described as a triangle of three key components, namely the road user (human) the vehicle and the road characteristics.

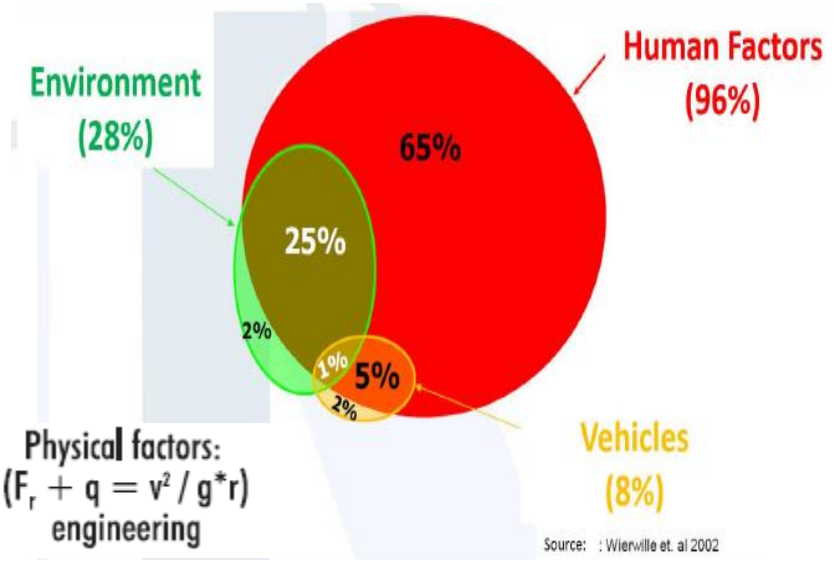


Fig-29 key components of road transport system.

Source. Wierwille et.al 2002

Each of these components can contribute individually to traffic accidents. However, these are most often the results of complex combinations and interaction between these components.

- Interactions between vehicle and road which described in several technical guidelines used by road engineers.
- Interaction between road user and vehicle (human-machine interface). The ergonomic needs of drivers and passengers are taken into consideration by the car industry.
- Interaction between roads which is the field of human factor specialists. These interactions are not very well described in existing technical guidelines.

A desirable approach would be to start with human physiological and psychological capabilities and limitations and to use these as a basis in road and traffic engineering. Road designers should ask themselves why new black spots sometimes appear after the construction of road projects that conform to existing standards.

They must realize that human is not infallible but, instead, that they make errors for a variety of reasons, some of which are linked to the application of design principles that interfere with drivers' perceptions.

It is well known that human factors have an enormous impact on the safe handling of technical systems. Since 1970 several design standards have been developed to prevent human errors in many technical fields such as a household appliance, industries, aviation, and vehicle manufacturers.

Building roads are the domain of the engineers. Defining the needs of road users is the domain of psychologists. There is a gap between these two professions that need to be bridged to develop better self-explained roads that will have the necessary features to reduce drivers' errors and accidents efficiently. Road engineering standards should be based on human behaviour, needs, capabilities, and limitations. Various aspects of the road conditions affect a driver's choice of speed:

1) Overall Road Condition: Road environments that yield a general feeling of comfort increase speed (generous alignment, wide lanes, smooth road surface conditions, clear roadsides, low traffic conflict potential, etc.)

2) Contrast: When the contrast is decreased (e.g., rain, fog) the ability to estimate speeds and distances are reduced (drivers underestimate their speed)

3) Focus distance: Longer focus distances increase speed.

5.2) Perception

Human beings can only process a small proportion of the stimuli found in the road environment. What they perceive is filtered selected and condensed Several factors influence perception, including.

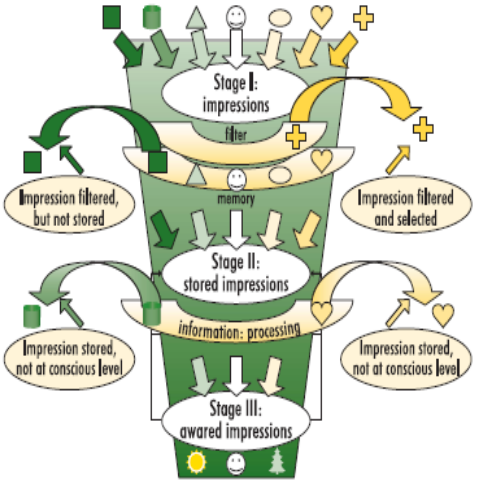


Fig-30 The perception process.

Source Birth,2000 based on Goldstein,1997.

5.3) Optical illusions

Many optical illusions can lead to incorrect estimations of speed, distance, direction, lane width, curve radii, etc.

Lane width illusion: the convergence of orientation lines leads to an incorrect estimation of object sizes such as lane width.

The Hering illusion is one of the geometrical-optical illusions that when two straight and parallel lines are presented in front of the radial background (like the spokes of a bicycle), the lines appear as if they were bowed outwards. The Muller-Lyer illusion is another optical illusion in which two lines of the same length appear to be of different lengths. The convergence of orientation lines may also lead to incorrect estimation of distances. For example, in the figure, the convergence of a tree line has the following effects:

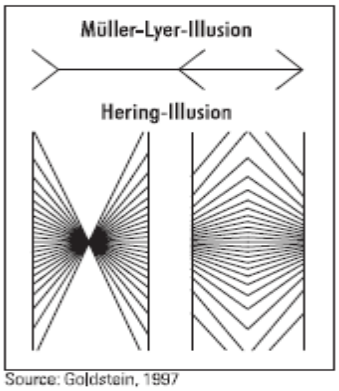


Fig-31 Optical illusion lane width

- The distance to the curve is perceived as being longer than the real distance (convergence is interpreted as an increased depth).
- The lateral distance of trees is overestimated.
- Drivers arrive at the curve earlier than expected, which may lead to over-steering maneuvers.

So convergent orientation lines should be avoided by marking, road edge, a line of trees or crash barriers.

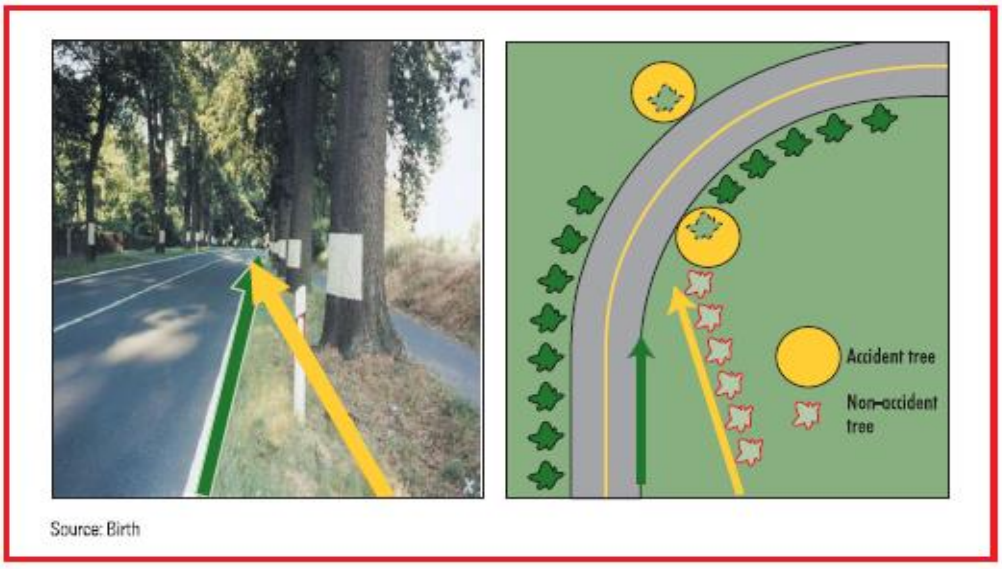


Fig-32 Optical illusion - tree line.

5.4) Curve radius illusion.

The combination of a horizontal curve with a vertical sag curve suggests a broader horizontal curve radius than reality. Drivers who prepare to steer for a broader curve suddenly must slow down and correct their steering when approaching the curve. This is an accident-prone situation that should be avoided. Conversely, the combination of a horizontal curve with a vertical crest curve suggests a narrower radius than reality. This situation is much safer.

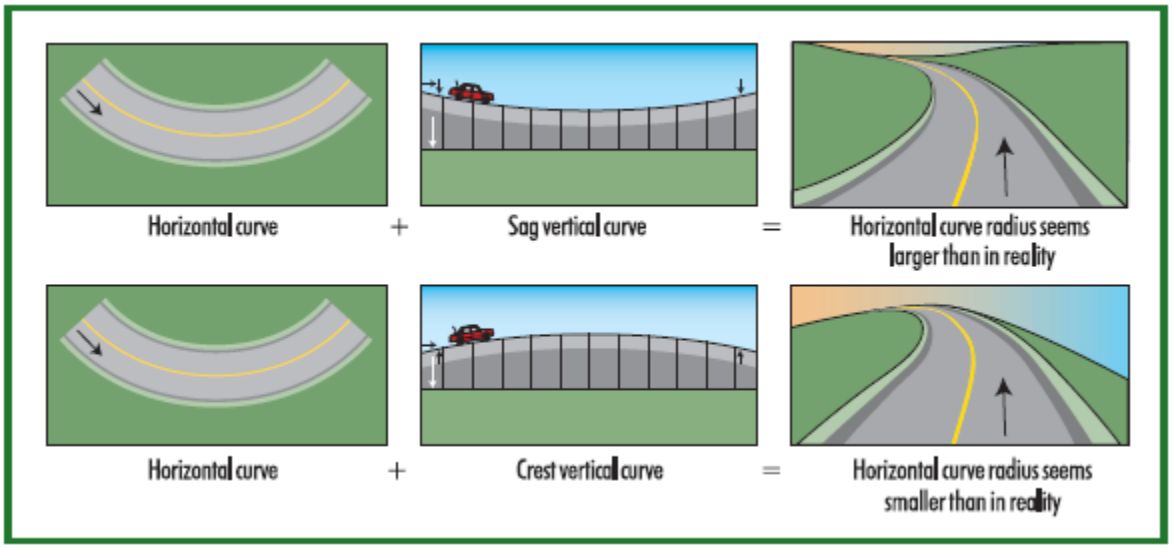


Fig-33 Optical illusion - combination of horizontal and vertical curves.

5.6) Contrast and light conditions.

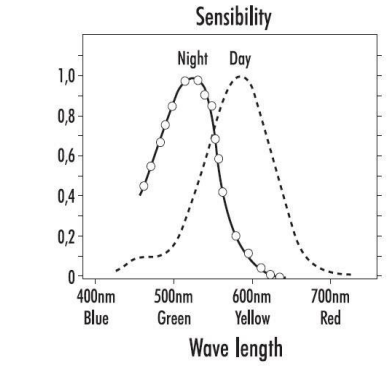
5.6.1) Background problem.

The possibility of distinguishing foreground and background information is critical in the detection of road signs and safety devices. Road engineers should ensure that adequate discriminative contrast is always provided between road features and their background (seasonal variations, sunrise, sunset, night-mode, etc.)

Source: Goldstein

Fig-34 example- poor contrast between foreground and background.

High light density and contrast reduce reaction time. For road surfaces, moderate light density has been correlated with lower accident frequencies. Rapid changes in brightness create stroboscopic effects that can disturb a driver's vision and perception. Road conditions that may create such effects should be avoided.



At night, blue and green colours are easier to detect than red.

Source: Goldstein, 1997

The combination of blue and white on road signs is easy to detect in day time and nighttime.

Source: VSVI

Fig-35 Left: Color sensibility (day and night), Right: Road Sign–Germany Freeway.

Contrast	Light Density	Perception
1:4	10 cd/m^2	20 ms
	60 cd/m^2	10 ms
1:6	10 cd/m^2	15 ms
	120 cd/m^2	5 ms
1:26	10 cd/m^2	10 ms
	250 cd/m^2	3 ms

Table-4 Impact of light density and contrast and perception-time

5.6.2) Audible and visible cues.

The reaction time depends on the type of message. Drivers react faster to audible signals than to visual signals. They also react faster to a combination of audible and visual signs than to a single signal.

Signal	Reaction Time (ms)
Audible	150
Visual	200

Table-5 Reaction times versus signal type.

5.6.3)) Age group (needs of older drivers).

The needs of older drivers should be considered at the design stage. Because they have:

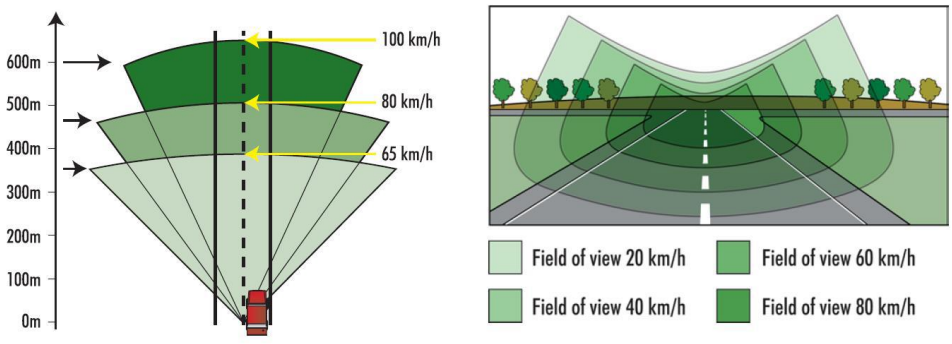
- Longer reaction time
- Reduced psycho-motor capabilities
- Reduced visual capabilities (visual acuity, the lateral field of view, contrast-sensitivity, susceptibility to blinding, perception of moving objects).

point of fixation			color detection	
Age	Point of sharp fixation of letters/signs (cm)		Age	The threshold for visibility of light wavelength (nm)
< 40	23		< 34	300
< 50	40		34 - 43	313
< 60	100		43 - 67	350
< 70	400		> 67	400+

Table-6 visual capabilities versus age. Deep Violet cannot be seen with increasing age.
Source. Goldstein,1997

5.7) Focus, Peripheral vision, and Driver's field of view.

There is a relationship between the focus distance and speed when speeds need to be kept low (e.g., Residential areas); roads should be designed to avoid long focus distances. The faster the speed, the narrower is the field of view. This should be taken into consideration when choosing the lateral offset distance of road signs. However, one must make sure that road sign poles do not become in themselves a road hazard.



Source: Based on cohen,1984 Based on Leutzbach and Papavasiliou,1988.
Fig-36 Left: Speed and focus point, right: Speed and peripheral vision.

The width of a driver's field of view is influenced by his driving experience and the nature of the road environment (urban or rural). Optimum Angle of View is:

- vertically: 20° up and 60° down
- horizontally: 15 - 20°

Drivers Experience	Road Type	Extension of the visual field		
		Vertical	Horizontal (100m)	Horizontal (200m)
Experienced	Urban	≤ 5°	9 m	18 m
	Rural	9° - 10°	18.5 m	37 m
Inexperienced	Urban	≤ 5°	9 m	1 m
	Rural	6° - 7°	13 m	26 m

Table-7 Visual fields of view

5.7.1) Speed and distance estimation.

Since drivers have trouble estimating speeds and distances, adequate cues need to be provided to assist them in these tasks.

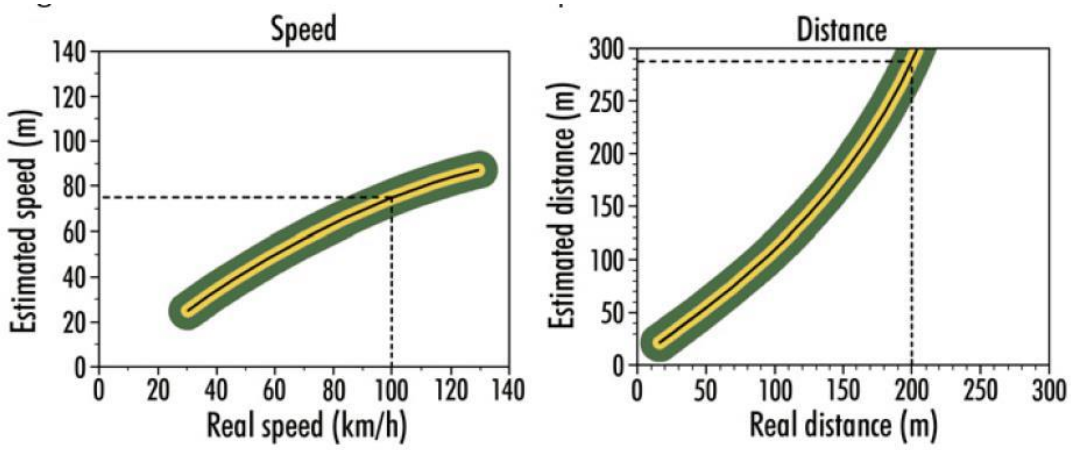


Fig-37 Estimation Errors

5.7.2) Orientation and anticipation

Orientation is defined here as the awareness and perception of spatial relationships while driving. Anticipation is defined as the active search for information and the determination of driving after detecting a new situation. To improve both orientation and anticipation, two basic requirements need to be met:

1) A sound road categorization system.

5.7.3) Human contribution to road accidents.

Human factor specialists seek to understand the contribution of human in road accidents, in order to propose solutions that will break the chain leading to accidents. Driving performance is influenced by the workload level (Yerkes-Dodson law) Both information under load and overload may lead to slips and lapses.

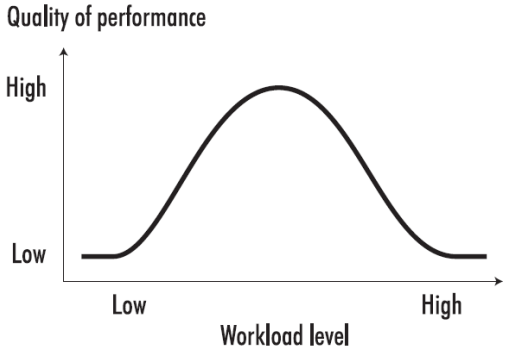


Fig-38 Yerkes–Dodson law

Information under load decreases a driver's attention and awareness. Some drivers may compensate by increasing speed. In order to reduce the monotony of a road environment, changes may be made to the road alignment, marking, planting, etc.

Fig-39 Low workload level

Human capacity in processing information is limited. The number of bits of information that can be processed simultaneously is 7±2. As such, road engineers should avoid the superimposition of critical information at the same location.

Fig-40 High workload level

5.8) Controlled Zebra Crossing.

Near the zebra crossing very one have be to slow down to avoid crash or accidents vehicle should maintain low approach speeds (up to 50km/h) and low traffic volumes (less than 500 vehicles per hour two-way without a refuge island or 750 vehicles per hour two-way with a refuge island). They are not suitable for areas of high pedestrian movements such as busy shopping streets or near train stations, as high or continuous pedestrian flows can cause excessive traffic delay [6]. The stripes are typically 40–60 cm wide. The pedestrian crossings are highlighted on the roadway by means of stripes with white stripes parallel to the direction of travel of the vehicles, with a length of not less than 2.50 m, on local roads and the urban ones of the neighborhood, and at 4 m, on other roads; the width of the strips and the intervals are 50 cm. In order to highlight the pedestrian crossing and avoid illegal parking near it, it is advisable to insert in the pavement white zigzag strips placed both along the edges of the roadway, before and after the "zebras," which in the middle of the same.

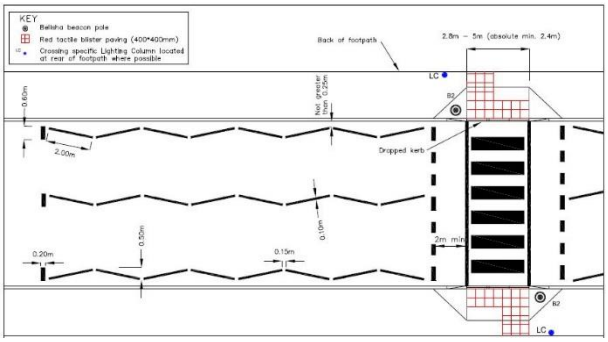


Fig-41 Zebra crossing.

If the existing street lighting is not enough, then additional lighting should be provided at pedestrian crossing points. This additional lighting throws a band of light across the road at the crossing location and shines directly onto pedestrians waiting at the curb, ensuring that there is excellent visibility of pedestrians on and approaching the crossing during the hours of darkness. Lamp columns can either be located at the rear of the footpath, up to a maximum of 3m from the edge of the road, or for zebra crossings they can be combined with the Belisha beacon lamp.

5.9) Raised crosswalks.

A raised crosswalk is a higher section of pavement with a marked crosswalk. It is placed across the street to encourage drivers to slow down. A typical height for a crosswalk with a standard 2m ramp would be 80mm and could change according to the length of the ramp. benefits are as follows:

Daylighting in advance of a cross- walk makes pedestrians more visible to motorists and cars more visible to pedestrians. This may be accomplished by restricting parking and installing a curb extension.

Fig-42 Raised crosswalks.

1) Stop lines at midblock crossings should be set back 20–50 feet. This ensures that a person crossing the street is visible to the second driver when first driver is stopped at the stop line.
2) Stripe the crosswalk, regardless of the paving pattern or material. Otherwise, drivers are not likely to see it, especially at night.
3) Medians or safety islands create a 2-stage crossing for pedestrians, which is more comfortable and safer.
4) At crucial access points to parks, schools, and waterfronts, and at intersections with local streets, raised crossings to increase visibility, yielding behaviour, and create a safer pedestrian crossing environment.
5) Keep crossing distances as short as possible using tight corner radii, curb extensions, and medians. Interim curb extensions may be incorporated using flexible posts and epoxied gravel.
6) Keep crossing distances as short as possible using tight corner radii, curb extensions, and medians.

A transition zone consists of several parts:

Drivers preparation with signing and warning -Warning section e.g., riding distance 3-4 sec.

-Drivers anticipation with the time of identification of unexpected situations: decision sight distance ,2-3 sec.

- Drivers response section and vehicles response – (Stopping sight distance, 2-3 sec plus braking distance for vehicle response).

On a level roadway the distance can be determined using the following formula.

$$d = \frac{V^2}{2gf} = \frac{V^2}{2(9.81)f} \times \left(\frac{1000}{3600}\right)^2 = \frac{V^2}{254f}$$

Where d= breaking distance (m)

V= initial speed (Km/hr)

F=co-efficient of friction between tires and the roadway 0.15 to 0.5

SSD (stopping sight distance) = 0.278tV+d (m)

T =perception and reaction time 1 to 2.5 sec (sec).

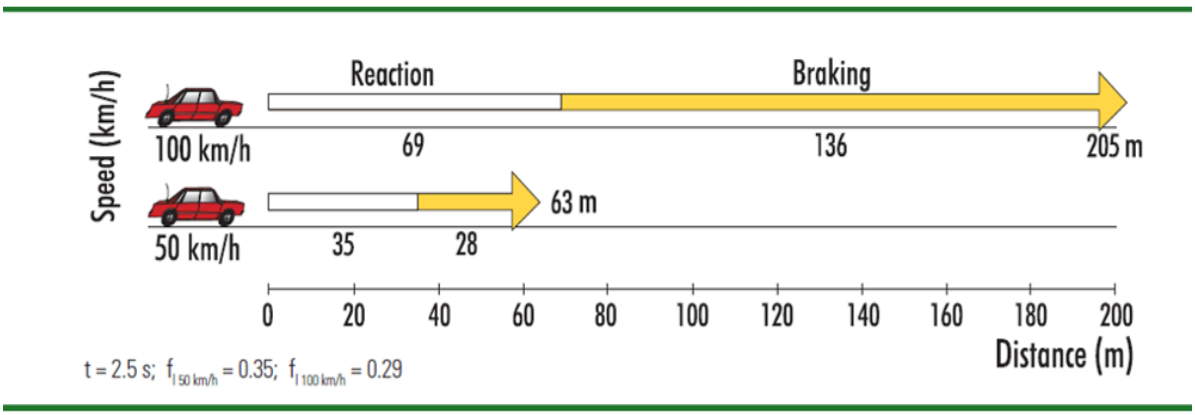


Fig-43 Sample showing the comparison of Braking distance for vehicles with initial velocities 100 and 50 km/hr respectively.

Conclusion

In this chapter briefly described usage of road to protect the road safety measures is an important criterion for all road users specially for pedestrian area walking through the road the drives must have given precedence to people who pass over the zebra crossing. If one vehicle stops for people who cross the road other vehicle must wait until they cross completely. If road vehicle does not respect the rule of road regulations, there may be chances of getting accident.

The drivers must keep in mind do not drive so faster or sole the speed should be control always vehicle should be maintained in regulating speed as per the road safety roles by the government. Before and after the covid-19 crisis the road traffic role must have followed as some decision taken by world health organization specially restriction in travel point of view in pandemic many changes and measures are taken by the organization during crisis for road safety.

Chapter - 6

Methodology

Eye Tracking Technologies (Mobile Eye), able to continuously track the gaze of the user. Eye tracking is a sensor technology that enables to know exactly where user eyes are focused. It determines user attention, focus, drowsiness, consciousness, or other mental states. The mobile eye was born as a marketing tool to understand the products that attract more attention on supermarket shelves. The producer changes the colours and the lettering of the products based on the consumer's choice.

Another tool that is used for this research is VBOX instruments for recording data related to the motion of a vehicle. The VBOX Pro combines a Global Positioning System (GPS) data logger with a high-quality multi-camera video recorder and real-time graphics engine, in fact, the connection between human behaviour and car kinematics. Also, this is used to collect the required data, such as speed, acceleration, braking distance measurement, and vehicle dynamics, etc. The GPS is a global navigation satellite system that provides geolocation and time information to a GPS receiver anywhere. In road transportation, Majority of users of this technology are taxi services, emergency vehicle location, commercial fleet management, and freight tracking, public transport monitoring, dispatch, and navigation and most of the new car models come with a factory-fitted GPS. GPS technology combined with Intelligence Vehicle Highway Systems is used to improve highway safety and ease congestion. Integrated Traffic Management Systems requires accurate data that is available in real time. This is to ensure that the necessary authorities can manage the travel time and speed to monitor and control congestion.

6.1) Mobile Eye XG (ASL)

6.1.2) Instrumentation and installation.

The "Mobile Eye" uses a technique of eye tracking known as "Pupil to CR" Tracking for monitoring and tracking the gaze of the human eye. This method uses the relationship between two eye features, the black pupil and mirror reflections from the front surface of the cornea (Corneal Reflections, or CRs), to compute gaze within a scene. A set of three harmless near infra-red (IR) lights is projected on the eye by a set of LEDs. The near IR light is not visible to the user, so it does not cause a distraction. However, it is a visible camera on the "Spectacle Mounted Unit" (SMU). The mirror reflection of these

three lights from the front surface of the cornea appears in the camera image as a triangle of three dots, at a fixed distance from each other, called the Spot Cluster. When the eye rotates in its socket, the center of the pupil moves relative to the spot cluster. The eye tracking system can compute the pointing direction of the eye, by comparing the vector (angle and distance)

Fig-44 Mobile Eye XG equipment of the ASL Applied Science Group Company.

between the pupil and one of the Corneal Reflection in the spot cluster. Main components are the SMU, composed of two cameras installed on special glasses; a "Display / Transmit Unit" (DTU), and a ME PC (laptop) with compatible software. The SMU consist of two cameras, “eye camera” and “scene camera.” The eye camera sees the reflection of the eye from a mirror fixed on the lens capable of reflecting the infrared radiation (IR) that are invisible to the human eye. The scene camera is instead directed to the surrounding environment. The video of both cameras can be recorded simultaneously. The ME PC processes the videos taken by the two cameras and visualizes the point of view as a cursor, superimposed on the scene image, records this 30 Hz image in "avia" format video.

The tools that make up the system are the following:

Mobile Eye XG Spectacle Mounted Unit (SMU), including the eye camera, the camera scene and the adjustable mirror installed on the glasses.

Fig-45 Mobile Eye XG Spectacle Mounted Unit

Display / Transmit Unit (DTU)

Fig-46 Display / Transmit Unit (DTU)

Mobile Eye PC (ME PC), has the size of a standard laptop CAT cable 5 (for the connection between ME PC and DTU) .

Fig-47 Mobile Eye PC

Below figure shows the connection diagram between the various components that make up the "Mobile Eye XG."

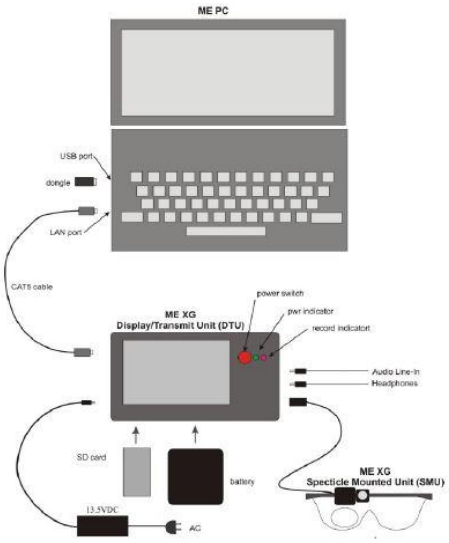


Fig-48 Interconnections between components

6.1.3) Anatomy of the human eye.

In this initial section, we give a brief overview of the anatomy of the human eye and clarify several terms that will be used in this thesis. In figure 2.1 a graphical representation of a human eye is given. A short introduction of relevant terms:

• Lens: focusses light rays to the retina

• Retina: sensory membrane that receives images formed by the lens and converts them into signals to the brains.

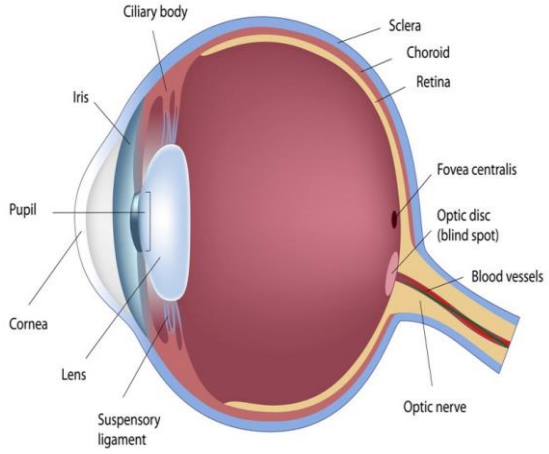


Fig-49 Anatomy of the human eye.

Briefly, the light follows the following path before reaching the retina:

Light → Cornea → Pupil → crystalline → Retina

Pupil: the round dark circle of the eye that opens and closes to regulate the amount of light the retina receives

• Iris: the colored part of the eye that surrounds the pupil. The iris acts like a diaphragm, and hereby opens and closes the pupil.

• Cornea: the clear part of the eye that covers the iris and the pupil.

• Sclera: the white of the eye.

• Limbus: the border between cornea and sclera.

• Fovea: the part of the retina that is responsible for accurate sight.

The eyes move within six degrees of freedom: three rotations and three translations within the socket. Six muscles are responsible for the movement of the eyeball: the medial and lateral recti (sideways movements), the superior and inferior recti (up/down movements), and the superior and inferior obliques.

Then the retina will record the images with the light receptors called rods. The rods, sensitive to light of low intensity, are about 120 million. They are distributed evenly over the entire retina, except in the area, called the fovea centralis, where the concentration of the cones is maximum. The cones, sensitive to intense light, are also responsible for color vision. In a smaller number of rods, about 6 million, the cones are not, in fact, all equal. Some of them are sensitive to red light, others to green light, others to that one blue variously stimulated, they allow us to perceive colors. Color blindness, disease genetics which involves the inability to distinguish specific colors, is generally due to the lack of red or green receptors. The light that arrives on the photoreceptor "impresses" them because it determines the rapid and complex reactions of the photosensitive pigments (i.e., sensitive to light) contained in them.

In rods, for example, there is a red pigment, the rhodopsin, which is formed starting from vitamin A. When light hits the rhodopsin molecules, they change generating nerve impulses which, through the optic nerve, reaching the brain. Vision requires the brain to process information gathered by the eye. This processing allows us to see three-dimensional images that are formed upside down, two-dimensional and small on the retina. Two eyes of the human allow a Stereoscopic vision. Eyes perceive two independent images of the same scene and send them to the brain which, comparing them, situates the objects observed in a three-dimensional space. Monocular vision and Binocular vision are two principles of spatial perception.

It should be noted that the Mobile Eye uses a non-coherent light. Incoherent sources emit light with frequent and random changes of phase between the photons (Tungsten filament lamps and 'ordinary' fluorescent tubes emit incoherent light). In a coherent source (laser) all the waves that are emitted start with the same phase. There are no abrupt phase changes within the beam.

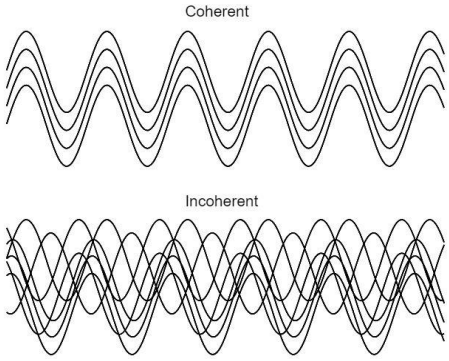


Fig-50 Incoherent and coherent light.

One of the most complete and authoritative sources on the safety of light sources is the manual "Safety with Lasers and Other Optical Sources" by David Sliney and Myron Wolbarsht, published for the first time in 1980 by Plenum Press. Quoting page 147 of this book: "Safe chronic eye exposure values, in particular for IR-A, are probably of the order of 10 m W/cm2 or lower". IR-A refers to the spectral band between 760 and 1400 nanometers, the interval in which the ASL Mobile Eye Optics Modules operate.

6.1.4) Eye vision of the human.

Approximately 90 percent of the information that drivers use is visual. While visual acuity is the most familiar aspect of vision related to driving, numerous other aspects are equally important. The following aspects of driver vision are described in this section:

- Visual Acuity: The ability to see details at a distance.
- Contrast Sensitivity: The ability to detect slight differences in luminance (brightness of light) between an object and its background.
- Peripheral Vision: The ability to detect objects that are outside of the area of most accurate vision within the eye.
- Movement in Depth: The ability to estimate the speed of another vehicle by the rate of change of visual angle of the vehicle created at the eye.
- Visual Search: The ability to search for the rapidly changing road scene to collect road information.

Peripheral Vision: The visual field of human eyes is vast: approximately 55 degrees above the horizontal, 70 degrees below the horizontal, 90 degrees to the left, and 90 degrees to the right. However, only a small area of the visual field allows accurate vision. This area of perfect vision includes a cone of about two to four degrees from the focal point. The lower-resolution visual field outside the area of perfect vision is referred to as peripheral vision. Although acuity is reduced, targets of interest can be detected in the low-resolution peripheral vision. Once detected, the eyes shift so that the target is seen using the area of the eye with the most accurate vision.

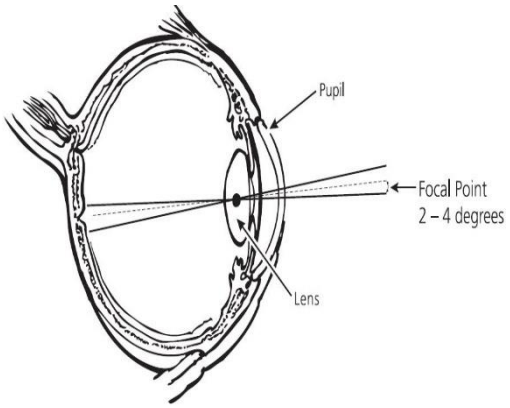
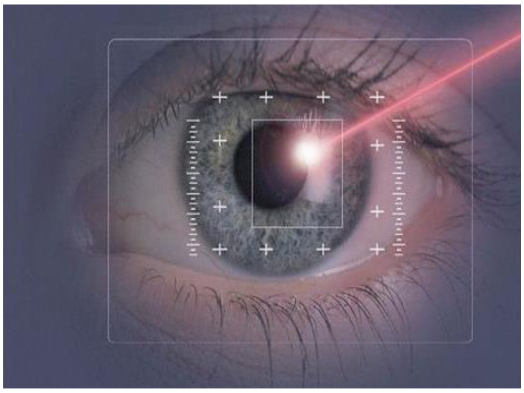


Fig-51 Area of Accurate Vision in the Eye (AASHTO).



The center of the pupil is tracked concerning to the position of the corneal reflection.

Targets that drivers need to detect in their peripheral vision include vehicles on an intersecting path, pedestrians, signs, and signals. In general, targets best detected by peripheral vision are objects that are closest to the focal point; that differ significantly from their backgrounds in terms of brightness, color, and texture; that is large, and that is moving. Studies show most targets are noticed when located less than 10 to 15 degrees from the focal point and that even when targets are conspicuous, glances at angles over 30 degrees are rare.

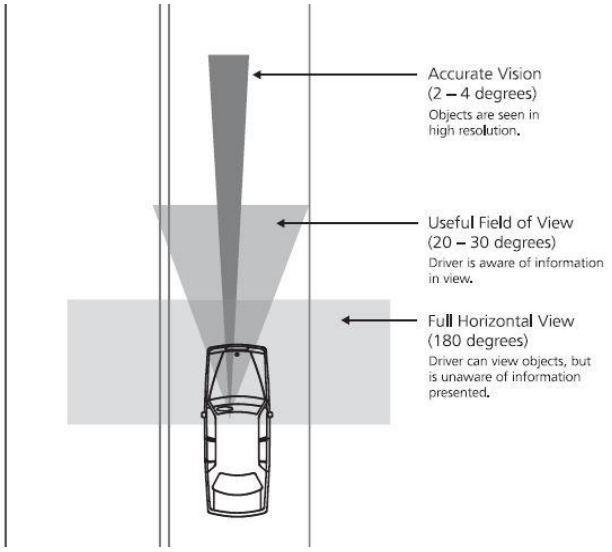


Fig-52 Relative Visibility of Target Object as Viewed with Peripheral Vision.

Target detection in peripheral vision is also dependent on demands placed on the driver. The more demanding the task, the narrower the “visual cone of awareness” or the “useful field of view,” and the less likely the driver is to detect peripheral targets. While carrying out the driving task, the driver is aware of information seen peripherally, within the central 20 to 30 degrees. The driver can physically see information over a 180-degree area but is not aware of it while driving unless motivated to direct his or her attention there.

6.2) Eye Vision software

6.2) Position the Eye Image

Eye Vision program is used to position the eye image correctly. By selecting "Display" under the "Alignment" item, the procedure of aligning the eye image in the monitor can be followed by looking at the computer screen. It is essential that all three CR points are visible and that they are inside or very close to the pupil.

Fig-53 eye image alignment

6.2.2) Corneal Reflection (CR) Spot Recognition

The spot cluster is important for tracking the pupil center. For this reason, it is necessary to make calibration of the three CR points for each user by selecting "Display" under the heading "Spot" in the Eye Vision screen

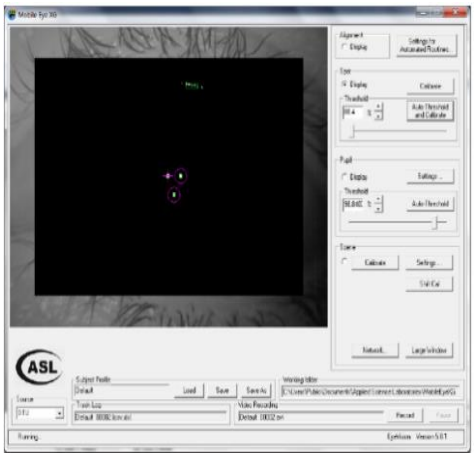


Fig-54 Spot cluster.

By clicking on "Auto Threshold and Calibrate" the software automatically calibrates the three CR points. The three CR points are visible on a black background. Two of these are circled in purple, while the third point is marked with a cross. The point with the cross is the "Master" or "Primary spot." It is important to make sure that the point selected as the master is the one that is less likely to be obscured during user operations. The point chosen as master can be easily changed by clicking on "settings."

6.2.3) Pupil Recognition

The pupil recognition phase is by clicking on "Display" under the heading "Pupil" in the right panel of the Eye Vision screen.

To perform an automatic recognition, click "Auto Threshold" under the heading "Pupil." The edge of the pupil will be indicated by a white line, formed by many white dots of different thickness. If the described object is recognized as the pupil, then it will be indicated with a yellow circle, approximately coinciding with the white outline, and with an always yellow cross indicating its center. The score number at the top left of the display is a measure of the reliability of the pupil's position. If it is below a certain limit, the pupil position for that frame is discarded.

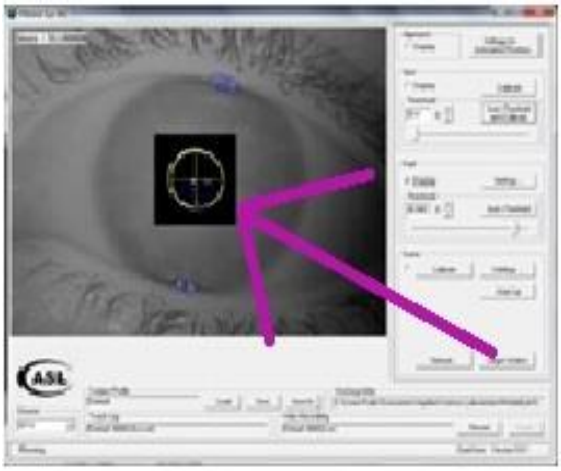


Fig-55 Pupil Recognition.

If the use of the automatic setting (Auto Threshold) does not produce the desired result, manual adjustments are available.

6.2.4) Scene Calibration.

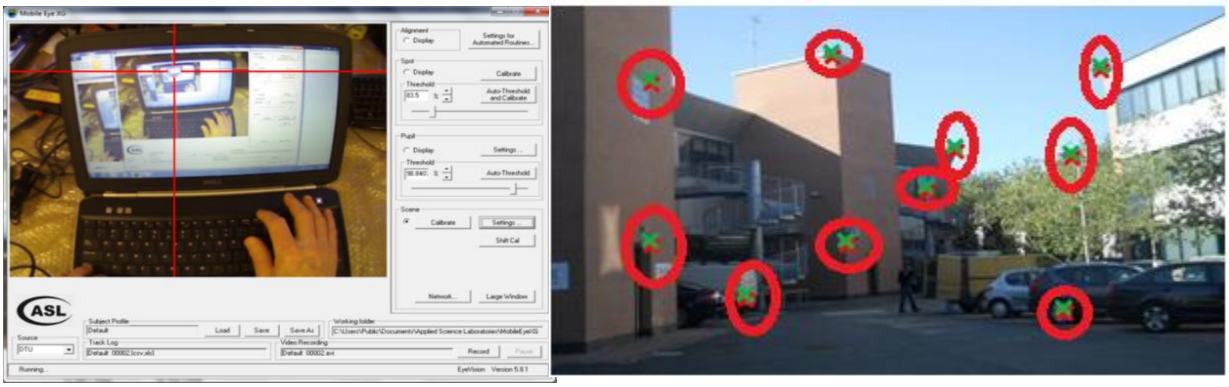


Fig-56 Left: scene calibration, right: calibration points are distributed across the scene.

In the calibration, the user must fix some points in the scene and mark these points. When the marker turns green, it is possible to create the profile of the user. It is essential that the green calibration points be distributed across the scene and not all in a single straight line with each other. The minimum number of points is three, but with more points, it will be possible to improve the accuracy of the tracking (ASL recommends using 5-10 points). This can be done by

selecting the "Scenes" section in the right panel of the Eye Vision software. The display shows the image taken by the camera.

This procedure can be performed either directly from the DTU, while the user is wearing the Mobile Eye, or with the recorded data reproduced by the DTU. If pre-recorded data is used, the calibration operation is performed in the same way during playback of the recorded video. The video will be displayed in the display window. Audio recording can often be used as a guide to find the points that the participant is watching.

6.2.5) V-BOX & Instrumentation.

The V-Box equipment is used to record data relating to the motion of a vehicle during a certain route. The data provided by the instrument are vehicle speed, accelerations transversal and longitudinal and tracking of the position in a possible predefined path. To test the sample data, the vehicle to be tested must be equipped with a device the video, the Video V-Box Pro, which combines a powerful GPS with high multi-camera quality, consisting of two coupled cameras working in synchronization with each other.

Fig-57 left VBOX Pro and right antenna and two cameras.

Apparatus

- 2x Camera Inputs (CAM1/CAM2); Resolution: 1920 x 1080p at 30 frames/second; Field of View (FOV): 148° horizontal, 86° vertical, 163° diagonal.
- Recording of GPS data at 10 Hz (all data recorded at ten times per second)
- Record on SD or USB card
- Predictive lap time (with OLED display)
- High-definition real-time graphics overlay.
- Video and MP4 audio recording
- Internal power backup for reliable recording

- Powerful data analysis software
- Up to 32 channel CAN inputs
- USB 2.0 host interface (for recording on USB flash drive)
- Camera preview via Wi-Fi
- Bluetooth LE connectivity

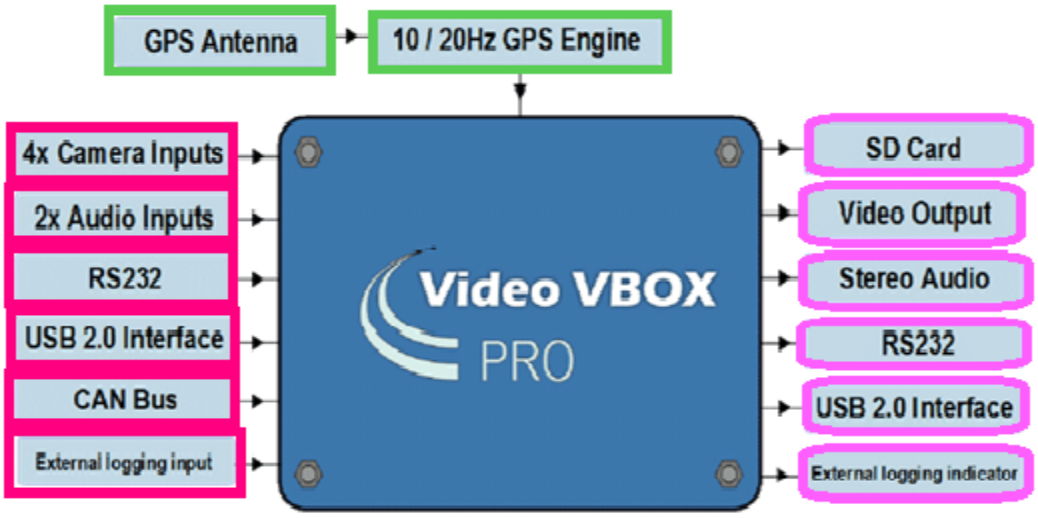


Fig-58 V-Box Pro and input and output parameters.

VBOX Video HD2 features 1080p video, real-time synchronized video/data with graphical overlay, Bluetooth, and Wi-Fi connectivity. The internal 10 Hz GPS engine recognizes the driving path and automatically configures the track map and lap timing. Automatic recording, a pre-record buffer, and internal power backup ensures that capture all the actions. The 10 Hz GPS characteristics in below table.

Velocity		Distance	
Accuracy	0.1 km/h (averaged over 4 samples)	Accuracy	0.05 % (<50 cm per km)
Units	km/h or mph	Units	metres / feet
Update rate	10 Hz	Resolution	1 cm
Maximum velocity	1600 km/h		
Minimum velocity	0.5 km/h		
Resolution	0.01 km/h		

Position		Acceleration	
2D Position	±3 m 95 % CEP[1]	Accuracy	1 %
Height	±10 m 95 % CEP[1]	Maximum	4 g
		Resolution	0.01 g

Heading		Lap Timing (OLED/ Circuit Tools)	
Resolution	0.01°	Resolution	0.01 s
Accuracy	0.3°	Accuracy	0.01 s[2]

Table-8 Hz GPS characteristics.

Chapter-7

7.1) Case Study and Data analysis with Results.

The Road Safety measures is the very important criteria for road users specially in pedestrian walk and zebra crossing design one should have to keep in mind while design the road plan that easy freeway or space to pass the vehicles and walking people on the pedestrian to zebra crossing the sufficient space gives users to cross easily. The use of traffic signal light and lighting performances on roads play an important role for the safety of roads from research studies we can define the lighting functioning. For this activity we have considered some selected drives with their vehicle for the test Led light that effect on drivers each of them was driven along the route by a vehicle equipped with V-box and V-box HD2 instruments are detecting acceleration, vehicle position, and distance. Mobile eye monitoring instrumentation was used in the experiment to map the movement of the driver's eye.

The driver activities in approach to the crossing the road were calculated.

a) basic condition with regular road lighting b) enhanced Led lighting that increased the level of lighting from 70 to 120lx c) flashing orange beacons on top of backlit pedestrian crossing sign d) continuous light emission in-curb Led strips. The results of V-box HD 2 and mobile eye monitoring were correlated with previous results of Led off condition.

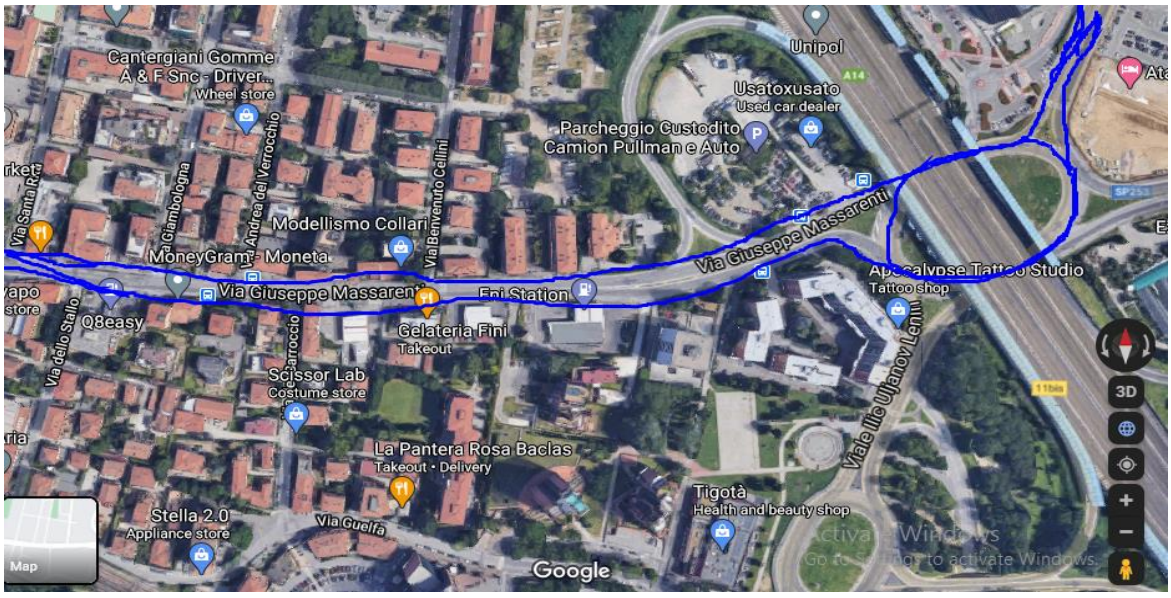


Fig-59 Zebra crossing view in study area via Giuseppe Massarenti location of site.

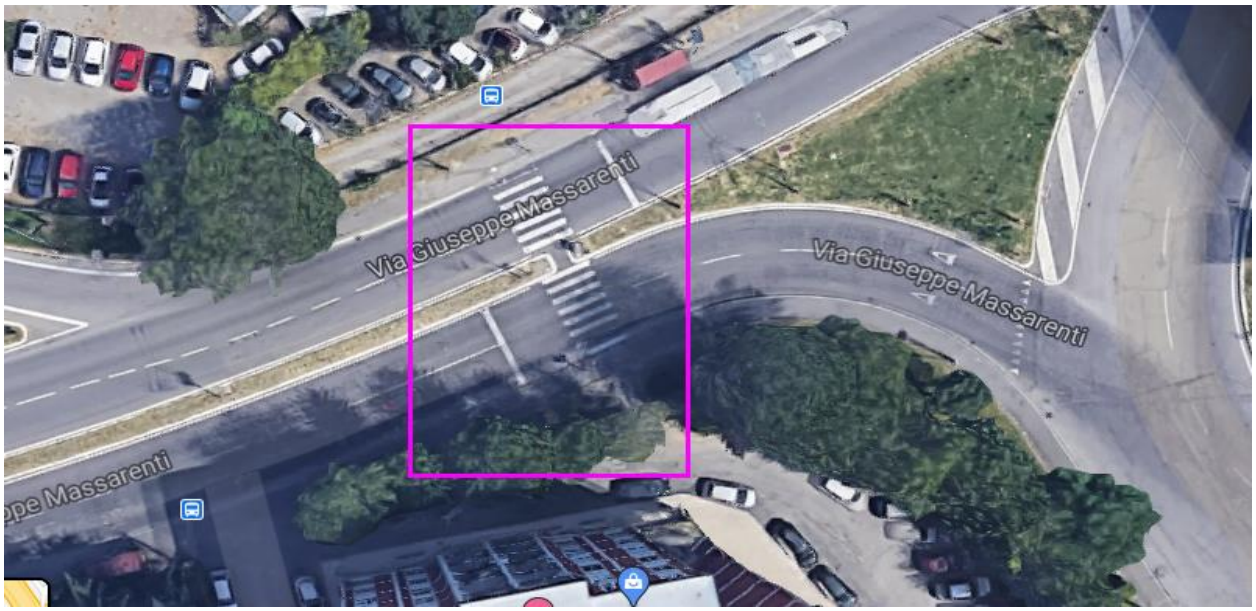


Fig-60 pedestrian to zebra crossing in via Giuseppe Massarenti.

The route chosen for the experimental phase belongs to the Bologna road network, via Giuseppe Massarenti., characterized by a length of about 1.2 km. The starting point of the experiments was the intersection of via Giuseppe Massarenti, and via larga. The end point was the roundabout behind the Marconi Airport and then return to the starting point again.

via Giuseppe Massarenti classified as an urban area street, which means is characterized by a single carriageway with two lanes, and sidewalks; for parking, there are areas equipped with a particular maneuver lane, outside the roadway. The maximum design speed is 60 km/h, while the minimum is 40 km/h; the speed limit is therefore 50 km/h. Regarding the geometric characteristics, the maximum transversal slope in the curve is 3.5%, while the maximum longitudinal slope is 8%. Each lane is 3 m wide, and the sidewalk is at least 1.5 m.

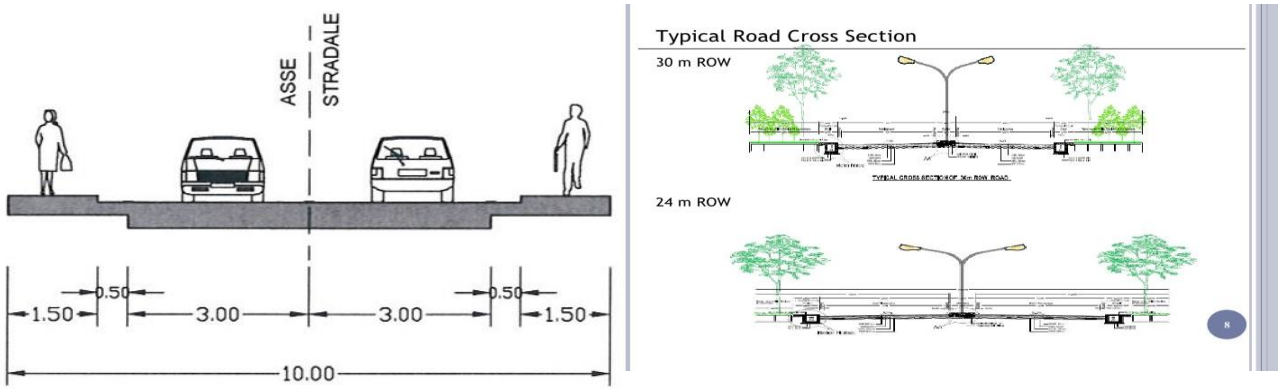


Fig- 61 left urban road section view design neighborhood street and right lighting system on road.

7.2) Pedestrian crossing characteristics.

In this below picture we different type of lighting system, one with embedded Led lighting in the curb test circuit includes the pedestrian crossing under study dedicated luminaires mounted 6 meters from the ground and the backlit pedestrian crossing sign with beacons The company that produced the pedestrian crossing lighting system is Zama Impianti S.R.L.

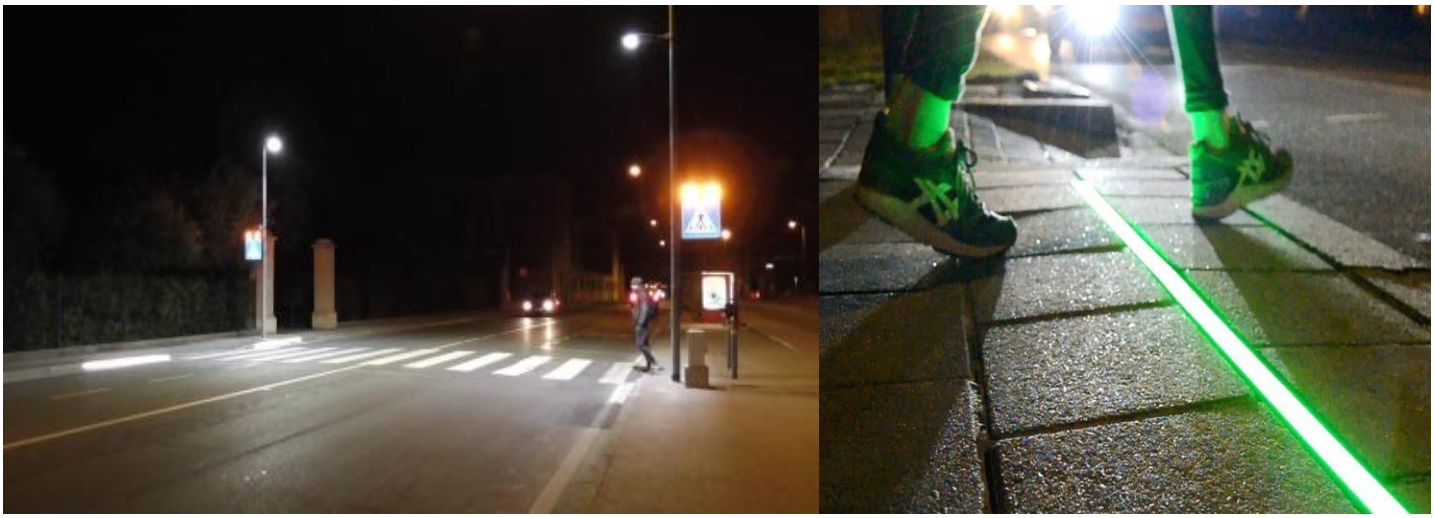


Fig-62 Pedestrian (Zebra) crossing object of study area.

The first type of lighting system of the crosswalk is called "LookAtMe" and consists of a LED system embedded into the curb of the road and activated by the optical sensors. This system makes the pedestrian passage more visible for motorists by producing an innovative light signal compared to the traditional one. The LookAtMe system has four bright LEDs, two of the embedded on each side of the pedestrian crossing on the curb. In general, this system composed of several elements.

Fig-63 “LookAtME” lighting system embedded in the curb, Zama Impianti S.R.L.

The other type of lighting system of pedestrian crossing present on the experiment site has an optical sensor for activation, i.e., the “SicurLed” LED-backlit pedestrian signal. This type consists of an aluminium box of 650x650mm and a thickness of 30mm, with a pedestrian crossing figure covered in very high refraction layer in Diamond Grade and Translucent class, LED-backlit uniformly in compliance with UNI EN 12899. The pedestrian signal is also supplemented by an "Active Flashing System" for pedestrian crossings: a system designed to highlight the approach of the pedestrian near the crossing, i.e., The system only works when the sensor detects one or more pedestrians on the edge of the pedestrian crossing.

Fig-64Sicurled LED Backlit pedestrian crossing sign.

This dynamic flashing light has several components:

- radio-synchronized timed retrigger able blinker with battery status check.
- wireless transmission system consisting of long-range radio control.
- spotlights 100/200 LED complying with UNI EN12352 Class L2H / L8H.
- power of 12Vdc supply with Photovoltaic Kit / Public Lighting Kit / 230Vac Kit.
- the control panel in cabinet VTR with Yale21 lock dimensioned for containing and wiring the control and power electronics.

The last type of lighting system is the “**Sicurlux Dedicated luminaries**”, one for each side, mounted at an elevation of 6 m on a cylindrical pole. The lamps were LED light sources. The level of illumination was increased when the sensor sensed a pedestrian, rising from 70 to 120 lx at street level (horizontal illumination measured at the center of the crosswalk, with the sensor facing upwards), and the system equipped with 25/50 LEDs lasting more than 100,000 hours.

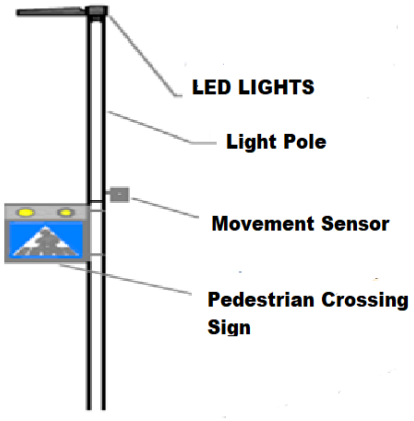


Fig-65 Luminaires mounted on cylindrical pole.

7.3) Execution of experiment.

In this experiment we considered around twenty road user drivers with having many years of experience also called as experts in driving, they had normal vision and none of them has glasses to avoid the back ground image moving object or artefacts. All of them are experienced drivers with valid driving license and none of them had any previous experience of the route used in the case study. Out off them I considered ten drivers for the experiment. Red colored boxes indicate the deleted data of 5 users in each as there is too much distraction and in Green colored shows the well and considered for the procedure few cases there are obstructions on the route.

USERS	Gender	NO	LED	Description
Marco	M	1	ON	COSIDERED
Gulia	F	2	ON	COSIDERED
Alexa	F	3	ON	COSIDERED
Giuseppe	M	5	ON	COSIDERED
Elina	F	6	ON	COSIDERED
Arben	M	7	ON	Too much distraction
Fedrico	M	8	ON	Too much distraction
Elvin	M	9	ON	Too much distraction
Monika	F	10	ON	Distraction due to vehicle crossing the road

Table-9 Showing the drivers users of road with Gender, name.

The drivers started and ended at the same intersection; half-way along the route, they reached another specified intersection and then returned through the opposite way to the starting point. Data collection was done during evening from 19:00 to 21:00 as LED lights are more crucial in the research. Each participant has driven the same car with manual gear. The car has been 64 equipped with device VBOX PRO. The drivers were wearing the device ASL Mobile Eye-XG equipment which has 2 digital high-resolution cameras attached to eyeglasses. Data was recorded at a speed of 30HZ with an accuracy of 0.5^0-1^0. An initial trail distance has been added to the whole path, to allow the

Fig- 66 equipment and driver wearing ME glasses.

driver get used to mobile eye equipment. The whole equipment was placed in back seat and were monitored.

7.4) Design calibration.

Every individual person, it is appropriate to perform an exact design calibration procedure for the apparatus. This is the stage in which the subject conducting the test must observe the points distributed in the scene and, eventually, the operator must confirm it to the computer. First, each participant was asked to be comfortably seated inside the vehicle, to change the seat and mirrors and to wear the glasses to continue calibration. The user was subsequently asked to imagine appropriate points that fill the visual field completely.

The subject must fix the gaze at each point, while the operator selects the same point on the computer screen with a mouse click. A specified point will be validated by the instrument. Only if there is a coincidence, for a certain tolerance, between that seen by the subject and that clicked by the operator, will the cursor on the point become green. This method will cause the red cursor in the output videos to be superimposed, reflecting the user's point of view on the environmental scene. When the calibration is done and the registration of the Mobile Eye and V-Box has started, the driving test starts on the route examined. The operator begins to record the eye and viewpoint via the above-mentioned instruments at the beginning of each examination. Thus, from the PC display, a red cursor superimposed on the surrounding world scene would be able to see the driver's point of view in real time. One of the operators warns another operator to cross the crosswalk as the vehicle reaches the examined crosswalk.

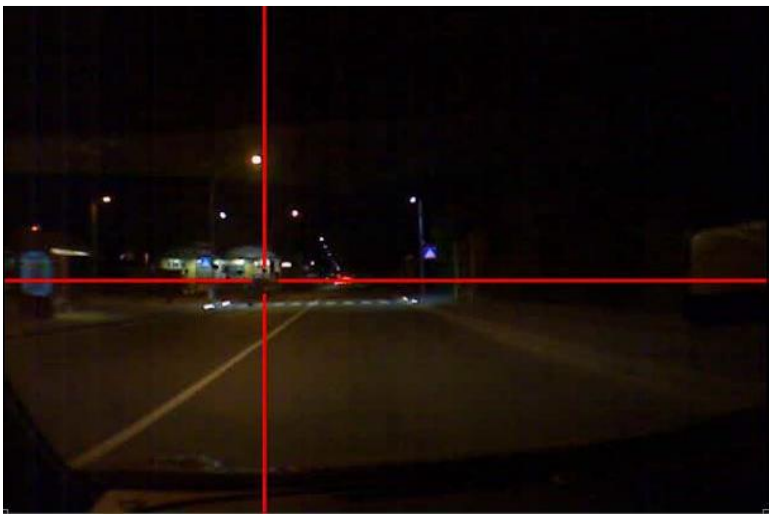


Fig-67Red cursor shows driver point of view.

7.4.1) Results.

The recorded of eye tracking data from the mobile eye and the data collected from V-BOX will be discussed. By using these two instruments, an attention/ distention analysis is carried out on the driver. It should be noted that the Mobile Eye and the V-BOX have been coordinated for each one for the study, so that the times referred to are similar for both instruments. After the point of interest (pedestrian crossing) was established, the Mobile Eye video was paused to measure distances and frame by frame analysis, and the progressive video was collected using the Circuit tools program.

7.4.2) Camera Frame by frame analysis.

With the help of using mobile Eye tracker, makes it possible to discover the user visual behavior. A red cursor can achieve this by pointing precisely to the elements, thus we identify the elements observed by user in each video by wearing eye tracking glasses. All recorded of users were analyzed one by one, making an excel file for each user where all significant elements of pedestrian crossing were included. This study was conducted only for the condition when LED is on and the values were compared with LED off condition.

Street
Private access
Roundabout
Traffic island
Roundabout sign
Bus stop
Pedestrian crossing signal

Table10 Element considered in the analysis.

Other sign
Stripes
Street lamp
Stripes
LED light Right
LED light left
Right Blue Pedestrian crossing signal
Left blue pedestrian crossing signal
Right flashing light sign
Left Flashing light sign
Vehicles in the same lane
Vehicles in opposite lane
Vehicles in roundabout
Parked vehicles in same lane
Vehicles in entering
Parked vehicles in opposite lane
Cyclist on road
Pedestrian
Pedestrian crossing the road
Inside vehicles
Sky
Sky line
Surroundings

Above table data shows attention/distraction analysis has done As, Green ones indicates attention elements whereas red indicated distraction elements. Every frame-by - frame analysis (1 frame = 0.033sec) was conducted for each user, in which frame-by - frame analysis was defined on what the user's gaze was based on via the use of Kinovea software. The starting frame ID number and the number of consecutive frames during which the user observes the same entity should be recorded in an Excel file. Fixation can be defined as maintaining visual gaze on a single location. An object was considered as fixated when it was fixed for a minimum duration of two frames (66ms). Fixation durations has been interpreted, in the context of reading as the amount of information processed in a fixation.

Elements	Attention	Disattention
street	×	
private access	×	
roundabout	×	
traffic island	×	
pedestrian path	×	
roundabout sign	×	
pedestrian sign	×	
other signs	×	
pedestrian strips after the roundabout	×	
main pedestrian strips	×	
LED (right)	×	
LED (left)	×	
blue pedestrian lighting (right)	×	
blue pedestrian lighting (left)	×	
flashing light (right)	×	
flashing light (left)	×	
vehicles in the same line	×	
vehicles in the roundabout	×	
vehicles in entering	×	
park vehicles in the same line	×	
cyclist on the road	×	
pedestrian on the side of the street	×	
pedestrian crossing the road	×	
looking forward (skyline)(horizon)	×	
bus stop		×
street lamp		×
vehicles passing in the opposite line		×
vehicles parked on the other side		×
inside vehicle		×
sky		×
surroundings		×

Table-11 Attention-Disattention elements.

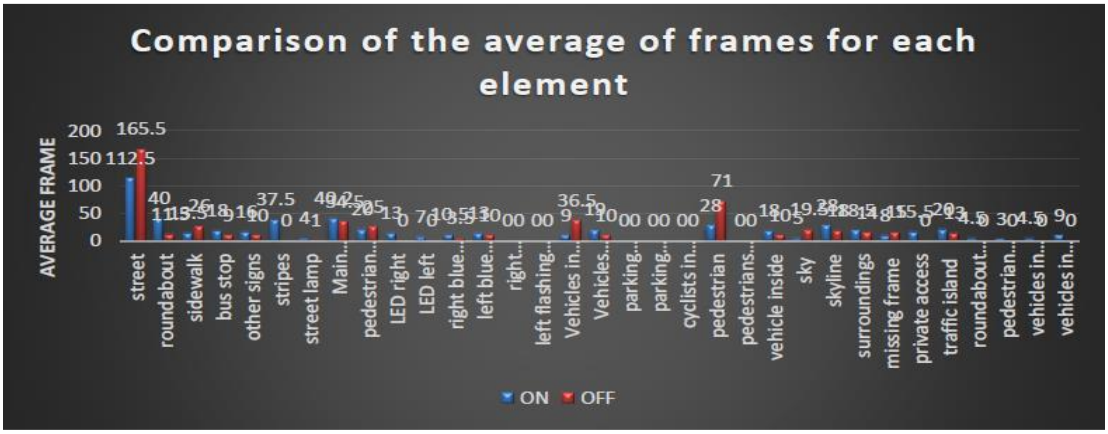
FIXATION DURATI	strada (street)	ACCESSI PRIVATI (private access)	rotatoria (roundabout)	SPARTITRAFFICO (traffic island)	MARCIAPIEDE (sidewalk)	SEGNALI ROTATORIA (roundabout sign)	FERMATA AUTOBUS (bus stop)	SEGNALE ATTRAVERSAMENTO PEDONALE (pedestrian crossing signal)	ALTRI SEGNALI (other sign)	STRISCE PEDONALI (stripes)	luce lampione (street lamp)	strisce pedonali (stripes)	cordolo destro (LED right)	cordolo sinistro (LED left)	segnale blu luminoso destro (right blue pedestrian lighting sign)	segnale blu luminoso sinistro (left blue pedestrian lighting sign)	VEICOLI STESSA CORSIA (vehicles in the same lane)	VEICOLI CORISA OPPOSTA (vehicles passing in the opposite site)	VEICOLI IN ROTONDA (vehicles in the roundabout)	VEICOLI IN IMMISSIONE (vehicles in entering)	PEDONE (pedestran)	INTERNO VEICOLO (inside vehicles)	cielo (sky)	ORIZZONTE (skyline)	AMBIENTE (surroundings)	FOTOGRAMMI PERSI (missing frame)
gabriel	196		57		8				117			39		37								1			34	5
eugenio	123	60	3		15		6		5	27	16	14					41	50	4	13			26		7	28
Fredretik	242	5			15			3	12	16	4	59	32	4	1		9	3				31	2	9	5	
Jacobo	102		40		5	8			4		26	43					43		5			30	14	8	40	34
Mostafa	298								16		1	29	11	25	9		13	7		9		6			33	4
ALESSANDRA	92	14	29	11	23		52		44	33		36	3	10		20	1	8						50	29	8
ALESSANDRO	114		46	32	25	1	18		26	20	4	34	15	2	19			30		7			4	8	33	1
GRETA	111	54							5	5		40		1			1	5					6	35	1	18
MATTIA TOMASIN	73	17			12					22		57	2			6		37		4	1			28	0	73
CLAUDIA	78	8		20	10				18	17		18	75		12		7	69		12	55		4	46	8	2
MEDIAN	112.5	15.5	40	20	13.5	4.5	18	3	16	20	4	37.5	13	7	10.5	13	9	19	4.5	9	28	18	5	28	18.5	8
	3.375	0.465	1.2	0.6	0.405	0.135	0.54	0.09	0.48	0.6	0.12	1.125	0.39	0.21	0.315	0.39	0.27	0.57	0.135	0.27	0.84	0.54	0.15	0.84	0.555	0.24

Fig-68 Fixation duration for all users.

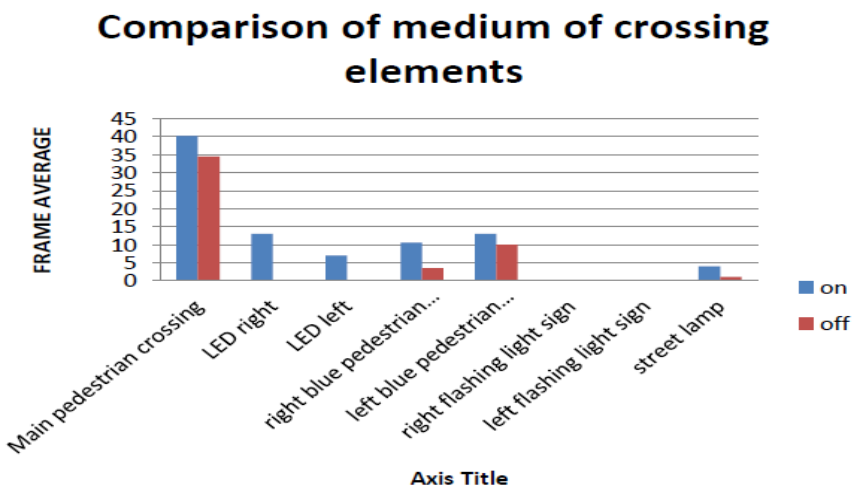
	strada (street)	ACCESSI PRIVATI (private access)	rotatoria (roundabout)	SPARTITRAFFICO (traffic island)	MARCIAPIEDE (sidewalk)	SEGNALI ROTATORIA (roundabout sign)	FERMATA AUTOBUS (bus stop)	SEGNALE ATTRAVERSAMENTO PEDONALE (pedestrian crossin	ALTRI SEGNALI (other sign)	STRISCE PEDONALI (stripes)	luce lampione (street lamp)	strisce pedonali (stripes)	cordolo destro (LED right)	cordolo sinistro (LED left)	segnale blu luminoso destro (right blue pedestrian lighting	segnale blu luminoso sinistro (left blue pedestrian lighting	VEICOLI STESSA CORSIA (vehicles in the same	VEICOLI CORISA OPPOSTA (vehicles passing in the	VEICOLI IN ROTONDA (vehicles in the roundabout)	VEICOLI IN IMMISSIONE (vehicles in enterin g)	VEICOLI IN SOSTA STESSA CORSIA (parck vehicles in the	CICLISTI IN STRADA (cyclist on the road)	PEDONE (pedestran)	INTERNO VEICOLO (inside vehicles)	cielo (sky)	ORIZZONTE (skyline)	AMBIENTE (surroundings)	FOTOGRAMMI PERSI (missing frame)
Eugenio	19	3	1		3		2		2	8	4	3					6	7	1	2					7		1	6
Fredretik	30	1			4			1	3	2	1	6	5	2			2	1						5	1	2	1	
Gabriel	18		1		1				13			3		4													2	
Jacobo	13		3		1	1			1		4	6					6		1					4	1	1	7	10
Mostafa	15								5			4	1	2	1		1	1		1	1			1			3	1
CLAUDIA	11	1		2	1				1	3		3	12		2		1	8		1			4		1	11	2	
ESSANDRA	14	1	2	2	3		8		10	5		6	1	1		2		2				4				7	3	1
ESSANDRO	15		5	2	3		3		5	3	2	9	4	1	5			3		2					1	2	3	
GRETA	18	7							1	1		4						2							1	7		3
IA TOMASINI	9	3			1					2		6	1			1		7		1						4		8
Median	15	2	2	2	2	1	3	1	3	3	3	5	2.5	2	2	1.5	2	2.5	1	1	1	4	4	4	1	4	2.5	4.5

Fig-69 Fixation number.

By collecting all the data from eye tracking, Average number of frames for all elements was compared for both LED on and OFF cases.



Graph-6 Average number of frames for all elements for both ON and OFF cases



Graph-7 comparing Average number of frames for main crossing elements in both scenarios ON/OFF.

For all crosswalk elements the values are higher for LED ON case. This means with the LEDs on, especially the attention of users towards the pedestrian has increased. Furthermore, the percentage of attention and distraction is plotted for two situations (ON/OFF).

7.4.3) In case of attention-distraction analysis.

The attention and distraction main elements for crossings are Stripes, LED, Blue pedestrian crossing Signs. The elements of distraction are defined as those elements that, especially near crossings and intersections, can cause a danger both for vehicles on the roadway and for weak road users, such as pedestrians and cyclists. This type of evaluation was chosen to be able to subsequently make a comparison between OFF / LED regarding attention and distraction. Once all the frames for each user were collected, a summary table was created in which the sums of all the frames seen by each user were inserted, for each element of the route. More precisely, pie chart is generated to show attention and distraction of all users.

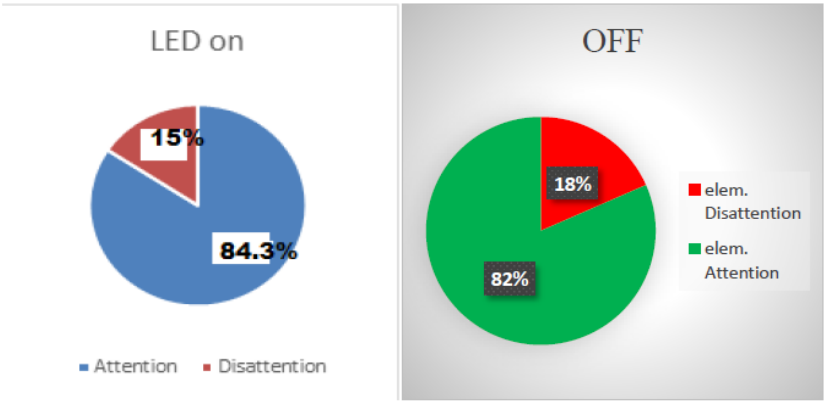


Fig-70 attention and distraction in percentages for both LED on and OFF scenarios.

7.4.4) V-BOX and circuit tools functioning.

The Kinovea software 'Circuit Tools' was used to process the data and perform the video analysis. The kinematic data of the car, essential to determine how the driving of the drivers along the route differs, can be read, and supplied by this software. The software allows the consumer to measure the various vehicle-related quantities that can be selected in the box where they are listed. In addition, by selecting one or more of these, the trend of the selected quantities, along with the entire direction, can be seen on the Cartesian plane, as a function of time. The specific values of each parameter, as well as the maximum and minimum values in each segment, and the route layout are also recorded in addition to the global trend along the route. In addition, the video displays the velocity (in km / h) and the transverse acceleration sustained by the vehicle moment by moment.

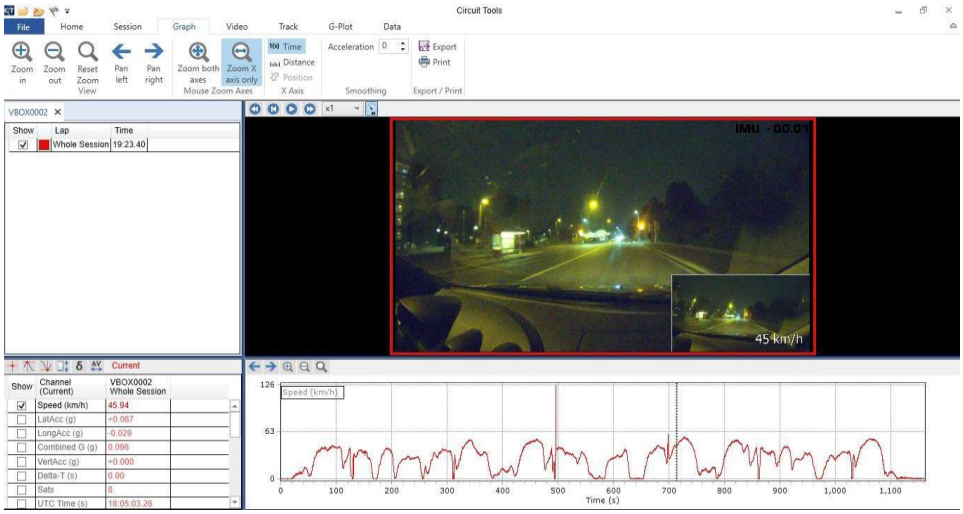


Fig- 71 video data processing with Circuit Tools.

In the destination folder, the exported file is saved. The file that the Circuit Tools software obtains is a text file that needs to be translated to a .xlsx file to process the data. Open the file in Excel, pick the entire column containing all the data and reorder the text in columns with the command "Text in columns" command in the Excel menu. The distances (m) and the UTC time, which is the time measured by GPS, are the Excel spreadsheet data necessary to analysis vehicle performance. In addition, two additional columns were added, one in which the time (ME) was entered in seconds, i.e; the time read by the Kinovea software and registered by the Mobile Eye Tracker, synchronized correctly with the UTC time; the other column was inserted to add the frame number shown on Kinovea.

Reference points that can be seen in the images, such as the moment when the traffic light green was activated, generating an Excel column with relative time, were defined in order to correctly combine V-Box data with those from the Mobile Eye. Next to UTC Time, to the Mobile Eye. To do this, he looked for the same moment when looking at both videos at minimal speed. In this way, it was possible to synchronize the Mobile Eye time in seconds with the V-Box UTC, to obtain a unique correspondence between the videos. The Kinovea software was used to analysis the location of the frame-by-frame vehicle for each person, starting from the Eye Tracker video. It is possible to obtain a correspondence not only in relation to the times of both video files, but also a correspondence between the data supplied by the V-Box (speed, location, distance) and the frame supplied by the Mobile Eye by means of the synchronization just illustrated. From those excel files, we considered distance and velocity values in 3 phases i.e., 150 meters before crossing, at the crossing and 50 m after the crossing.

7.4.5) Perception at braking distance of 55 meters.

While considering initial velocity as 50 km/hr; we considered SSD (stopping sight distance) of 55 meters. So, for all the values of velocity and distance from the excel file by considering the approximate nearest SSD of 55 m Box plots were plotted for both scenarios of LED on and off conditions.

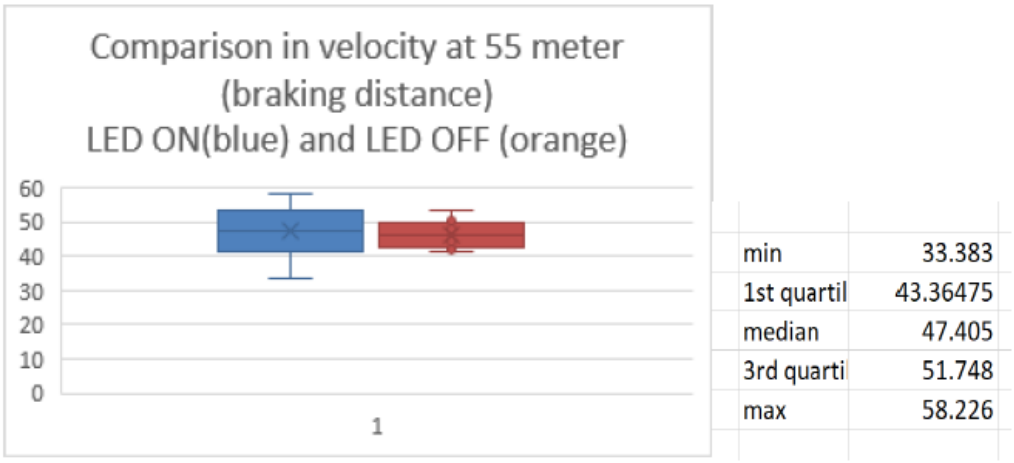


Fig-72 V-box and the values.

	dist	vel	Velocity-new	old
alessandra	-55.68	51127	51.127	42.736
Alessandro	-55.54	57240	57.24	47.743
Greta	-55.54	58226	58.226	53.233
CLAUDIA	-54.97	42689	42.689	45.306
Mattia	-54.55	45392	45.392	50.771
EUGINE	-55.36	47909	47.909	41.9
FEDERIK	-54.55	46901	46.901	42.145
JACOBO	-54.72	51955	51.955	48.895
GABRIEL	-54.14	37609	37.609	50.184
MUSTAFA	-54.79	33383	33.383	41.486
				44.514

Fig-73 Velocity and Distance values of both scenarios.

Above table shows the values of velocity and distance for all the users before 150 meters of crossing and 50 meters of crossing. Led off scenario velocity values were also considered to get the comparison. It is interesting to see the change in braking distances from the crosswalk, from which driver tends to slow down. For the LED off case the average distance is almost 34meters before the stripes, whereas with the LEDs on, we can see the rise in distance of around 55 meters.

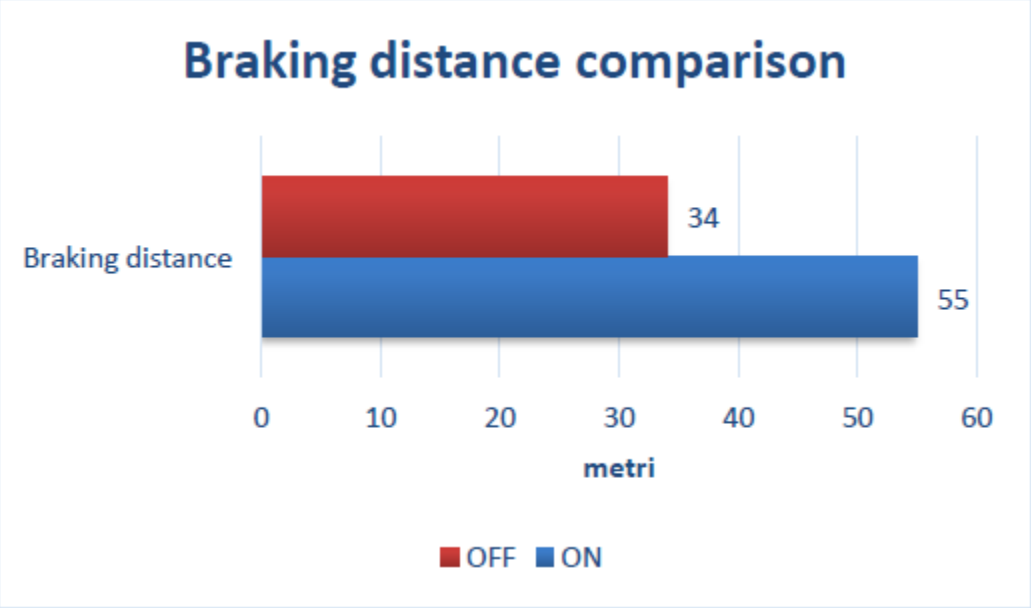


Fig-74 Comparison of braking distance for both scenarios (ON/OFF).

P value is calculated by comparing mean values of OFF/ON velocities.

T.TEST p-value = 0.729

Conclusion.

Overall in this research to define a good report to prepare it is a really new to study on for impact on transportation during crisis when started working on it gradually finding such interesting topic on covid-19 crisis impacted on transportation as research goes deep and deep many new things come to an existence, as we saw the in crisis the European countries have major impact on transport many issues on maintaining safety distances, especially in Lombardia, Milan metropolitan city in Italy. Government of Italy lunch the new DPCM in very month to regulate the safety of all around the county. But covid-19 cases are not in control when the crisis is beginning there no lockdown in starting stage traffic as usual move on the buses, private car, motor cycle and bicycle in normal way travel around country. In the month of March 2020, the rapid increase in covid-19 cases a sudden lockdown come to an existence travel and transport has closed the economy of the country jumps very low. European union decided to close the school and started a remote learning activities and county borders were shut in crisis.

World road association (PIARC) team efforts to control down the problems when rises in the country pass the quick knowledge to protect the road safety and safety for the people on the roads communication of the organization is very strong in resolving the issues throughout the world. Road safety measures also taken by the PIARC in pandemic as a result new construction of roads to construct new lines of roads to reduce the number of accidents.

Asian countries in covi-19 lockdown have imposed large-scale stay-at-home and quarantine notices and implemented safety measures to move work and schools online learning activities for students. The countries have very less income in crisis those who have small scale of business many countries economy in fluctuating specially in India covid-19 hits the country in large number of cases it stands the second in world transport was shut the border of the country were closed in lockdown restrictions in travel cancelation in air flights.

In the experiment of LED lights of via Giuseppe Maserenti roads while crossing the pedestrians or (zebra crossing) the evaluation of results shows from the frame-by-frame analysis we made attention and distraction statistics we got some positive results as the total number of attention frames were increased. However, the flashing sign has the function of warning to the driver the presence of a crosswalk nearby, thus making him slow down. The results show that with the presence of LED, the driver is tending to reduce the speed thus, the safety of the pedestrian

crossing was increasing. But, if the drivers take the same route twice or thrice, as they are getting more familiar to roads, they are more inattentive to the crossing.

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References.

[1] Binkin, N., Michieletto, F., Salmaso S., Russo, F. (2020). Protecting our health care workers while protecting our communities during the COVID-19 pandemic: A comparison of approaches and early outcomes in two Italian regions. *MedRxiv*. https://doi.org/10.1101/2020.04.10.20060707.

[2] D., Tirani, M., Rovida, F., Demicheli, V., Ajelli, M., Poletti, P., et al. (2020). The early phase of the COVID-19 outbreak in Lombardy, Italy. *ArtViv on line*. https://arxiv. org/abs/2003.09320.

[3] OpenStreetMap community. Open street map wiki, 2020. Online at: https://wiki.openstreetmap.org/wiki/ Main Page.

[4] The World Bank. Map of SME-Support Measures in Response to COVID-19, 2020. Online at: https://www.worldbank.org/en/data/interactive/2020/04/14/map-of-sme-support-measures-in-responseto covid-19.

[5] Peter Mooney and Levente Juhász. Mapping covid-19: How web-based maps contribute to the infodemic. Dialogues in Human Geography, 10(2):265–270, 2020.

[6] Harant, P., Hastert, M. and Scheres, J. Hospital Co-operation in Border Regions in Europe. Leuven, HOPE, Standing Committee of the Hospitals of the European Union, 2003.

[7] "Covid-19 lockdown estimated to cost India $4.5 billion a day: Acuité Ratings," Hindu Business Online, 2 April 2020, https://www.thehindubusinessline.com/ economy/covid-19-lockdown-estimated-to-cost-india45-billion-a-day-acuit-ratings/article31235264.ece

[8] Safety, Road, and Annual Report. 2019. "Road Safety Annual Report 2019.

[9] Simone, Andrea, Murad Shoman, and Valeria Vignali. 2018. "Looking behavior to Vertical Road Signs on Rural Roads." *MOJ Civil Engineering* 4(2):75–79.

[10] José Manuel Blanco Segarra, Spain, Secretary of Committee on Performance of Transport Administrations (TC1.1).

[11] Chair PIARC TC A.1 Performance of Transport Administrations (2016-2019).

[12] "Pedestrian Safety Guide and Countermeasure Selection System."

[13] A. Simone, *Unibo Road Safety Engineering Course*. 2019.

[14] R. Van Houten, J. E. Louis Malenfant, D. Mccusker, and H. R. Municipality, "Advance Yield Markings Reduce Motor Vehicle/Pedestrian Conflicts at Multilane Crosswalks with an Uncontrolled Approach."

[15] R. A. Retting, S. A. Ferguson, and A. T. McCartt, "A Review of Evidence-Based Traffic Engineering Measures Designed to Reduce Pedestrian-Motor Vehicle Crashes," *American Journal of Public Health*. 2003.